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Exploratory Fishing and Hydroacoustic Observations of Rockfish off Brooks Peninsula, Vancouver Island, From the *MV VELMA C* and *CSS JOHN P. TULLY*, March 13-23, 1989

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EXPLORATORY FISHING AND HYDROACOUSTIC OBSERVATIONS OF ROCKFISH OFF BROOKS PENINSULA, VANCOUVER ISLAND, FROM THE MV VELMA C AND CSS JOHN P. TULLY, March 13-23, 1989.

by

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ABSTRACT

Matthews, K. R., J. R. Candy, L. J. Richards, R. Kieser, and C. M. Hand. 1989. Exploratory fishing and hydroacoustic observations of rockfish off Brooks Peninsula, Vancouver Island, from the MV VELMA C and CSS JOHN P. TULLY, March 13-23, 1989. Can. MS Rep. Fish. Aquat. Sci. 2029: 101 p.

This report summarizes cruise results from two vessels operating in Brooks Bay, on the west coast of Vancouver Island, between March 13-23, 1989. The purpose of the joint survey was to describe rockfish communities on hard (untrawlable) bottom, and to compare these communities with similar communities on smooth (trawlable) bottom. In order to fish hard-bottom areas, the MV VELMA C, a chartered commercial longline vessel, deployed and retrieved sunken gillnets. Fishing was conducted in four habitat types identified by concurrent hydroacoustic observations from the CSS JOHN P. TULLY. These were: (1) smooth-bottom habitat generally within 100-200 m, (2) rough-bottom pinnacles with vertical relief of 10-20 m typically found between 95-130 m, (3) smooth plateaus adjacent to the shelf dropoff deeper than 170 m, and (4) the shelf dropoff at about 170-200 m. The distribution, diel behaviour, and biomass of fish schools in these areas was determined hydroacoustically. During the day, fish tended to concentrate near the bottom, and they became more dispersed at night. Transitions between night and day configurations occurred within 0.5 h. At least two types of fish schools were identified from echograms, one over rough-bottom pinnacles, and the second at the shelf dropoff. Catches of 55.3-78.5 fish/set and 5.3-8.3 species/set were obtained on pinnacles and deeper areas adjacent to the shelf dropoff, whereas the lowest catches (mean 23.3 fish/set and 2.3 species/set) were obtained on smooth-bottom areas. The catch was dominated by four species: lingcod Ophiodon elongatus (23.4%), bocaccio Sebastes paucispinis (18.7%), yellowtail rockfish S. flavidus (15.9%), and canary rockfish S. pinniger (15.5%).

RÉSUMÉ

Matthews, K. R., J. R. Candy, L. J. Richards, R. Kieser, and C. M. Hand. 1989. Exploratory fishing and hydroacoustic observations of rockfish off Brooks Peninsula, Vancouver Island, from the MV VELMA C and CSS JOHN P. TULLY, March 13-23, 1989. Can. MS Rep. Fish. Aquat. Sci. 2029: 101 p.

Ce rapport résume les résultats d'une expédition qui a eu lieu dans la baie Brooks, sur la côte ouest de l'île de Vancouver, du 13 au 23 mars 1989. Le relevé effectué à partir des deux navires en présence avait pour but de décrire les communautés de sébastes vivant au-dessus de fonds accidentés (non chalutables) et de les comparer avec des communautés similaires vivant au-dessus de fonds unis (chalutables). Un des deux navires, le MV VELMA C, un palangrier commercial affrété, a pêché au filet maillant dans la zone au fond accidenté. La pêche a eu lieu dans des milieux de quatre types délimités par des observations hydroacoustiques faites concurremment à partir du CSS JOHN P. TULLY: 1) un fond uni se trouvant généralement à une profondeur de 100 à 200 m; 2) un fond accidenté, habituellement à une profondeur de 95 à 130 m, parsemé d'aiguilles d'une hauteur de 10 à 20 m; 3) des plateaux unis situés à proximité du record de la plate-forme continentale, à plus de 170 m de fond; 4) le rebord de la plate-forme, à une profondeur de 170 à 200 m environ. On a déterminé par des moyens hydroacoustiques la répartition, le rythme nycthéméral et la biomasse de bancs de poissons dans les milieux étudiés. Pendant le jour, les poissons tendaient à se concentrer près du fond et la nuit, ils se dispersaient. Le changement de comportement au moment de la transition entre la période diurne et la période nocturne se faisait en 0,5 h tout au plus. Les échogrammes ont permis d'identifier au moins deux types de bancs de poissons, soit ceux qui se tenaient au-dessus des aiguilles et ceux qu'on a observés au-dessus du rebord de la plate-forme continentale. Le taux de capture était de 55,3 à 78,5 poissons et de 5,3 à 8,3 espèces par jeu de filets au-dessus des aiguilles et des zones profondes voisines du rebord de la plate-forme. Les taux les plus bas (23,3 poissons et 2,3 espèces par filet en moyenne) correspondaient aux captures effectuées au-dessus des fonds unis. Quatre espèces dominaient: Morue-lingue, Ophiodon elongatus (23,4 %), Bocaccio, Sebastes paucispinis (18,7 %), Sébaste à queue jaune, S. flavidus (15,9 %) et Sébaste canari, S. pinniger (15,5 %).

INTRODUCTION

This report summarizes cruise results from two vessels operating in Brooks Bay, on the west coast of Vancouver Island, between March 13-23, 1989. The purpose of the joint survey was to describe rockfish communities on hard (untrawlable) bottom, and to compare these communities with similar communities on smooth (trawlable) bottom. In order to fish hard-bottom areas, the MV VELMA C, a chartered commercial longline vessel, deployed and retrieved experimental sunken gillnets. Hydroacoustic observations were made concurrently from the CSS JOHN P. TULLY.

The survey was motivated by the hypothesis that hard-bottom areas provide refuge for rockfish, in particular, Pacific ocean perch (Sebastes alutus), from the commercial trawl fishery. If this hypothesis is true, then potential yields from these stocks could be greater than currently estimated. At present, little is known about fish communities on deep, hard-bottom habitats. This survey is the first step in a program directed towards examining this hypothesis. Due to equipment limitations, however, we were restricted to depths shallower than 200 m. This is shallower than the usual winter depth range of Pacific ocean perch.

The commercial rockfish fishery operates by bottom trawl, midwater trawl, and various line methods. Trawl gear could not be used on this survey, however, because of the high risk of net damage. Line methods were impractical, as they are too selective for the species and sizes of fish caught. As an alternative, we used a modified sunken gillnet. The specific objectives of the fishing component of the survey were to (1) evaluate the use of sunken gillnets for sampling rockfish on hard-bottom areas, (2) compare, with the use of sunken gillnets, the species composition of commercially important fish on hard and smooth-bottom areas, and (3) compare species composition of the catch by habitat type with fish targets observed in hydroacoustic surveys.

Information from gillnet catches was supplemented by hydroacoustic observations. Hydroacoustic methods are potentially important for describing rockfish distribution, abundance, and diel behavior. The specific objectives of the hydroacoustic component of the survey were to (1) calibrate the acoustic system on the JOHN P. TULLY using a standard target, (2) map the distribution of fish schools in Brooks Bay, (3) monitor typical fish schools over several 24 h periods, and (4) identify features of various fish schools and relate these features to the major species caught by sunken gillnets.

The survey was conducted in Brooks Bay, on the west coast of Vancouver Island (Fig. 1). This is one of the areas where hard-bottom habitat is found at depths within the Pacific ocean perch range. Brooks Bay was selected due to the proximity of the appropriate habitat to the coast, and ease of access.

This report is organized into sections by data type. Hydroacoustic methods, results, and discussion are presented first, and are followed by fishing methods, results, and discussion. Correspondingly, Appendix A contains information relating to the hydroacoustic data, and Appendix B reports details from gillnet sets.

HYDROACOUSTIC METHODS

HYDROACOUSTIC EQUIPMENT

The hydroacoustic system on the JOHN P. TULLY was configured for echo integration and analog recording of single and dual beam echoes. Conventional echograms were recorded and echo integration of fish densities was carried out in real time. Analog data were recorded for post-cruise digital processing to generate colour echograms, dual beam target strength and other results. The components of the acoustic system included a BioSonic model 101 echo sounder, model 121 echo integrator and model 111 thermal chart recorder. A Simrad model 11000 dry paper chart recorder was also used as it provided an annotated echogram that clearly identified 1-min echo integration sequences and 10-m range intervals. It also provided an opportunity to compare the legibility of dry and thermal paper for target identification and separation of targets from the bottom profile.

Depending on the measurement, either a 38 kHz single or a 120 kHz dual beam ceramic transducer was mounted in a torpedo shaped body that was towed behind the vessel. A towed body was used to carry the transducer as this led to reduced acoustic interference from the vessel and provided a stable, vertical transducer orientation. The towed body was equipped with a roll and pitch sensor that recorded the body's attitude on a strip chart recorder. It was towed at a depth of approximately 25 m and a speed of 8 kn. The distance to bottom is given in this report as the range, defined as the depth below the transducer. Hence, the distance from the surface to the bottom or the fish target is approximately 25 m greater than the range given.

CALIBRATION OF THE HYDROACOUSTIC EQUIPMENT

Two independent methods were used to calibrate the hydroacoustic equipment. The first calibration was based on standard hydrophone measurements, while the second used a standard target. The hydrophone calibration was carried out on February 21, 1989, at the calibration facility of the University of Washington, Seattle, before the equipment was installed on the JOHN P. TULLY. It included the 38 and 120 kHz transducers, cables and echo sounders. For each transducer the impedance and beam pattern were measured using a short standard connecting cable. This was followed by a system calibration for transmit level and receive sensitivity.

The target calibration method is described by Foote et al. (1987). Target calibration was conducted in Kendrick Inlet on March 14, 1989 from the JOHN P. TULLY. The calibration site was selected based on the following criteria: (1) location is protected from wind and waves, (2) currents near the surface and at depth are minimal, (3) water

depth is at least 20 m, (4) there is good anchorage, (5) tide is slack for a reasonable period of time, (6) few fish are present in the water column, and (7) location is isolated from other vessel traffic.

The calibration sphere was a 3.8-cm diameter tungsten carbide standard target. To conduct the calibration, a frame with three horizontal arms was attached to the towed body. Fishing reels and monofilament nylon lines along each horizontal arm were then used to position the calibration sphere below the transducer. The towed body, calibration frame and target were suspended from a large crane on the aft deck of the JOHN P. TULLY. To adjust the on axis position of the target, the apparatus was placed just below the surface. Measurements of the combined transmit level and receive sensitivity were conducted for the 38 and 120 kHz systems near the surface and at three depths to a maximum of 46 m.

TRANSECT LOCATIONS

Several sets of hydroacoustic transects of varying length were conducted during the cruise, as summarized in Table 1. Transects T1-11 (Fig. 1) provided an initial coverage of Brooks Bay. These transects occupied an area of 6x12 nm perpendicular to the shelf dropoff and covered a depth range of 50-300 m. A survey of transects T1-11 required approximately 6 h to complete. The survey was conducted twice, once during the day and a second time at night. Transects C1, C2, and C3 were located within transects T1-11 along depth contours at 90, 140, and 180 m, respectively (Fig. 2). These transects were chosen to determine the variability of different types of fish aggregations during the day at specific depths.

Although transects T1-11 covered a large area, they provided poor temporal resolution. In order to obtain repeated observations of a small area, four additional transects were chosen. These short transects, A1-4, were 3 nm in length, separated by 0.5 nm, and positioned such that A2 overlaid a segment of T9 (Fig. 3). This transect series was repeated 18 times within a 39-h period to monitor the diel behaviour of schooling fish observed in this area.

On March 19, we installed the 120 kHz dual beam transducer and the remaining transects were conducted with this system. Seven additional exposures of transects A3-4 were completed in order to record single fish echoes that were well resolved at night. Transects F1-2 were then chosen along the north-west side of T9 (Fig. 4). These transects were 1.5 nm in length and required only 0.5 h to survey. This further increased the number of possible repetitions over fish schools during the diel transition. Transects A3-4 and F1-2 were positioned perpendicular to the bottom contour. To provide more depth-specific information, additional transects G3-4 and H1-2 were selected along depth contours in areas where fish schools had been observed (Fig. 4). The location of these transects was chosen to coincide with fishing locations of the VELMA C.

Analog recordings of the echo signal were made on an 8 mm Sony DAV (Digital Audio Video) recorder, and after this instrument failed on March 19, on a 1/4" HP instrumentation recorder. Real time echo integration was possible until March 18 when the 120 kHz echo integrator failed (Table 1). Echo integration data were stored on an AST Premium 286 micro-computer with 40 Mbyte hard disk and 40 Mbyte streamer tape. A series of programs written in Turbo BASIC was used to acquire and analyze these data. The calibrated echo integrator measures the acoustic volume backscattering strength of the fish distribution. Given a fish target strength, the volume density of the fish distribution can be estimated. Area density and biomass estimates are obtained from the volume densities.

HYDROGRAPHIC STATIONS

A total of 15 STD cast locations were chosen along three parallel lines 6 nm apart, perpendicular to the shelf break in Brooks Bay (Fig. 1). Cast sites ranged in depth from approximately 15 m to over 300 m. Temperature and salinity were recorded for these sites using an Applied Microsystems Ltd. STD-12.

HYDROACOUSTIC RESULTS AND DISCUSSION

CALIBRATION OF THE HYDROACOUSTIC EQUIPMENT

Acoustic biomass density and fish size estimates are directly proportional to the transmit level TL and receive sensitivity RS. The values reported from the hydrophone calibration for the 38 kHz system (Appendix Table 1) are consistent with the calibration history that has been established for this system. The calibration of the 120 kHz system (Appendix Table 2) was the first of its kind. Typical hydrophone calibration accuracies are in the 0.5-1.0 dB (12-26%) range.

Target calibration depends critically on an accurate positioning of the calibration sphere in the centre of the acoustic beam. Figure 5 illustrates the rapid reduction of the echo as the sphere is moved from the acoustic axis. The sphere was suspended by three lines at a distance of 5.74 m from the transducer. The position of the sphere was adjusted by varying the length of the bow line. The length increment is given on the ordinate in Fig. 5. Echo voltage was read from an oscilloscope. The + and x symbols represent minimum and maximum observed values over a 2-min period.

Target calibration determines the combined transmit level and receive sensitivity, TL+RS. This value is shown for the 38 kHz system in Fig. 6 for transducer depths of approximately 1, 16, 32, and 46 m. The cluster of 8 points at the left in Fig. 6 was measured at a depth of 1 m. The points plotted at 0 and 1 m were measured before the transducer and target were lowered to greater depths, and points at 2 and 3 m were measured after the transducer and target had been lowered and returned to near the surface. The points plotted at 3 m were measured after the plexiglass shell that usually covers the towed body was reattached. It indicates that the two-way shell gain is -0.41 dB (a signal loss of 0.41 dB). The large decrease in signal variation at depth could be explained by reduced currents. Unfortunately the current depth profile was not measured. Combining the values plotted at 0, 1, and 2 m with those at 16, 32, and 46 m, it appears that TL+RS increases by 0.58 dB for depths greater than about 10 m. The dashed horizontal line in Fig. 6 indicates the equivalent hydrophone calibration result. It is 0.68 dB larger than the average TL+RS that was measured without the shell. These results are not significantly different, considering the hydrophone calibration accuracy of 0.5-1.0 dB.

Target calibration results for the 120 kHz dual beam system are shown in Fig. 7. The lower and upper series of points correspond to data from the narrow and wide beam (channel 1 and 2), and their difference is expected. The eight measurements at the left were made at a depth of 1 m. The first and last four of these were measured before and after the transducer was lowered to maximum depth. Both the narrow and the wide beam measurements have little scatter and no apparent depth dependence. The dashed horizontal lines indicate the equivalent hydrophone calibration results. For both channels, the average target calibration TL+RS value is larger than the hydrophone based value. A difference of 1.46 and 3.95 dB was observed for the narrow and wide beams, respectively.

ACOUSTIC OBSERVATIONS

Diel fish distributions

Figure 8 shows sections of night and day echograms from transect A1, using the 38 kHz transducer and 20 log R TVG (time varied gain). The top of the echogram is located 30 m below the towed body. The dark area represents the bottom profile. The narrow line following the bottom profile defines the top of the bottom window, below which return signals are truncated to prevent echo integration of the bottom signal. The pinnacle area shown in the night echogram (Fig. 8a) between sequences 92-96 is the same area as that shown in the day echogram (Fig. 8b) between sequences 744-748. A smooth area above the shelf dropoff occurs between sequences 97-103 and 749-757, in the night and day echograms, respectively.

The night and day echograms display different fish school configurations over the pinnacle area and near the shelf dropoff. From these echograms, it is possible to identify at least two types of fish schools. Over the rough pinnacle areas at a range of 70-100 m, schools appear as dense columns during the day. These become more dispersed at night.

Over the smooth bottom areas toward the shelf dropoff at a range of 120-150 m, schools appear as clouds which are most visible and furthest from the bottom at night. The lighter hazing seen on the day echogram is thought to be plankton. Transitions between night and day configurations occurred rapidly (less than 0.5 h).

Figure 9a shows the bottom range and the biomass centroid corresponding to the night echogram in Fig. 8a (transect A1). The biomass centroid in this context is defined as the mean range of the biomass density. Figure 9b shows the bottom range and the biomass centroid corresponding to Fig. 8b. Biomass densities for the night and day echograms are shown in Fig. 10a and 10b, respectively. Differences in night and day patterns of fish distribution are evident from comparing Fig. 9a with Fig. 10a and Fig. 9b with Fig. 10b. For example, the nighttime biomass centroid (Fig. 9a) is further from the bottom range than the daytime biomass centroid (Fig. 9b). The daytime biomass density (Fig. 10a) tends to be more concentrated than the nighttime biomass density and is restricted to the pinnacle area at sequence 747.

For each sequence, a mean value is calculated for the biomass centroid and bottom range. As rockfish are often very close to the bottom, especially during the day, it can be difficult to separate the bottom signal from fish targets. The effect of poor bottom tracking is evident in Fig. 8b, 9b and 10b. The integrator is unable to identify the bottom signal properly at sequence 751, resulting in a hole in the bottom window in Fig. 8b. A portion of the bottom signal is then integrated, resulting in a drop in the biomass centroid (Fig. 9b) and an inflated biomass density (Fig. 10b). If the bottom profile changes rapidly within a 1-min echo integration sequence and most of the biomass is located deeper than the mean bottom range for that sequence, then the biomass centroid for that sequence may appear below the range. This accounts for the drop in the biomass centroid in Fig. 10b at sequence 757.

Brooks Bay biomass estimate

Fish biomass densities were calculated by 1-min echo integration intervals for day and night observations along transects T1-11. These are shown as area density maps in Fig. 11. The transects are represented by the solid dark lines, with the vertical bars indicating density on a logarithmic scale of 0.001-0.1 kg/m^2. The maximum value is indicated by the dotted line parallel to the transect. Densities were calculated for a range of 50-100 m.

Fish that are very close to the bottom (within about 5 m on relatively flat bottom) cannot be detected with the echo integrator that was used during this cruise. Therefore, the estimate of the day biomass might be expected to be lower than that of the night biomass. Indeed, total biomass estimates for transects T1-11 are 1870 and 2050 t for day and night observations, respectively (Table 2). However, for a given transect, biomass estimates and the distribution of biomass changed considerably between night and day (Table 2, Fig. 11). During the day, fish are concentrated in dense schools near the bottom, becoming more dispersed at night. For example, the mean biomass centroid was

23 m from the bottom for the day observations, and 30 m from the bottom for the night observations (Table 2). Most of the fish that disperse up off the bottom at night are found near the 200 m depth contour (Fig. 11b).

Effect of depth and speed on acoustic measurement

The towed body can be lowered closer to the target to reduce acoustic noise. Attempts to lower the towed body by reducing vessel speed were unsuccessful, however, as the towed body tended to lose stability. When the towed body moved forward at a speed of greater than 3 kn, the roll/pitch sensor indicated a roll offset of 3° with a peak-to-peak amplitude of 1.5°, and a pitch offset of 1° with a peak-to-peak amplitude of 2°. When the speed was reduced to less than 2 kn, the offset for both roll and pitch was similar. However, the roll and pitch peak-to-peak amplitude increased to 18° and 12°, respectively, and a greatly reduced echo signal was observed. The frequency for both the roll and pitch is 1-2 Hz. A longer tow cable and depressor would allow the towed body to sink closer to the bottom while still maintaining a forward speed of several knots.

HYDROGRAPHIC STATIONS

STD site locations are shown in Figure 1. Temperature and salinity profiles for the 15 sites are shown in Appendix Figure A1. Most of the sites appear to be well mixed. Temperature, salinity, and current vectors are displayed in Appendix Figures A2a-A2d.

FISHING METHODS

VESSEL AND FISHING GEAR

The VELMA C, a 16.5 m (55 ft) long-line vessel (Appendix Table B1), was awarded the charter for the fishing survey. To sample the species composition of fishes on hard and smooth-bottom areas, we used sunken gillnets specifically designed for deepwater use (Fig. 12) and set them directly on the bottom. The gillnets were deployed off the stern of the fishing vessel and brought aboard with the use of a power block and stern drum. Each net was originally 91 m (50 fath) long and 7.3 m high; some nets were cut in half to 45.5 m to reduce their weight and retrieval time. Two different mesh sizes, 7.6 cm (3 in) and 15.3 cm (6 in), were originally used; the use of 15.3 cm nets was discontinued because fish became so entangled that it took an unreasonable amount of time to remove them.

Fishing began on March 15 and continued through March 23 with one day (March 21) lost due to weather, resulting in a total of 8 fishing days. Nets were either set in the late afternoon and left overnight or set in the morning and retrieved in the afternoon. The routine of setting and retrieving nets typically followed a pattern of: (1) searching, with the use of depth sounder and previously recorded LORAN coordinates, for the exact location of a specific habitat type, (2) setting the net off the stern of the boat, and (3) subsequently pulling the net off the bottom.

Because our cruise objectives required an accurate placement of nets on specific habitat types, it was important to not only locate a specific habitat type, but to verify that the net had indeed landed on the intended area. Placement and verification of net position was especially difficult on pinnacles. These were relatively small and discrete habitats, generally sloping off onto smooth areas. Thus, a considerable amount of time was spent estimating when the boat was initially approaching the intended area, when to release the net so it would land on the intended area, and subsequently, the position of the net.

Net retrieval was a time-consuming process, especially when nets were deeper than 160 m and heavy with fish. The best method to avoid breaking lines was to maintain the boat position directly over the net and to slowly haul the lines. One net (Set No. 2, a 91 m long net with 7.6 cm mesh) was never retrieved, as we broke the groundlines at both ends while attempting to bring it alongside the boat. We also broke groundlines on several other nets, but eventually were able to retrieve them from the opposite end. The groundlines we used were old and probably broke more easily than would new groundlines. Up to 1.5 h were required, from the time the buoy was initially secured, to slowly haul each net to the boat for subsequent fish removal. Removal of fish from the nets required from 0.5-2 h, depending on the catch and degree of fish entanglement.

FISHING LOCATION

The continental shelf break near the Brooks peninsula (Fig. 13) was chosen as our study area because it reportedly had hard-bottom habitats representative of untrawlable areas described by commercial fishermen. After research and boat personnel became familiar with the use of sunken gillnets, we directed our fishing effort on four common habitats observed in the 95-200 m depth zone: (1) smooth-bottom habitat generally within 100-200 m, (2) rough-bottom pinnacles with vertical relief of 10-20 m typically found between 95-130 m, (3) smooth plateaus adjacent to the shelf dropoff between 170-185 m, and (4) the shelf dropoff near 170-200 m. These habitat types were chosen as representative of the 95-200 m bottom off the Brooks peninsula from hydroacoustic bottom profiles run from the JOHN P. TULLY, as described above. Nineteen gillnet sets were made on the four habitat types (exact locations in Appendix Table B2) at depths between 97-201 m.

BIOLOGICAL SAMPLING

Our sampling strategy for the cruise was to collect information on rockfishes and lingcod with the following priorities: (1) Sample all juvenile (<20 cm) rockfish for length (forklength (FL) to the nearest mm), otoliths, and weight, and freeze samples for later species verification or if large catches occur. We only caught one fish <20 cm, a sharpchin rockfish, S. zacentrus. (2) For commercially important rockfish with current management plans (Pacific ocean perch, rougheye rockfish S. aleutianus, silvergray rockfish S. brevispinus, copper rockfish S. caurinus, widow rockfish S. entomelas, yellowtail rockfish S. flavidus, quillback rockfish S. maliger, canary rockfish S. pinniger, redstripe rockfish S. proriger, yellowmouth rockfish S. reedi, yelloweye rockfish S. ruberrimus) record length (FL), sex, maturity status, and weight and collect otoliths. Rockfish were weighed with an electronic balance accurate to the nearest g. (3) For other rockfish species record length (FL measured to the nearest cm) and sex only, using length-frequency forms. After set 8, we counted and discarded bocaccio S. paucispinus. (4) For lingcod Ophiodon elongatus, record length (FL), sex, maturity status, and weight and collect dorsal fin rays and tissue samples of male gonads. Lingcod were weighed to the nearest 0.5 kg using a beam balance. After we had collected data for 100 lingcod, we then collected information depending on whether or not the lingcod could be released alive. If alive, we measured length, sex, weight, and immediately released the fish. If dead, we recorded length, sex, maturity status, and weight. (5) Other species caught were identified and discarded at sea. Appendix Table B3 lists the common and scientific names and species codes used in the report.

FISHING RESULTS AND DISCUSSION

Nineteen gillnets were set and 18 successfully retrieved (Appendix Table B4). The average soak time for nets left in the water overnight was 17.6 h; the daytime sets averaged 4.5 h (Appendix Table B4). Depth reading ultrasonic transmitters (Vemco V1P, Vemco Limited, Nova Scotia) were attached to the gillnet float lines to verify that the net had reached bottom; bottom depth from the depth sounder was compared to the depth readout of the ultrasonic tag to determine depth of the float line relative to bottom. In addition, by monitoring depth readout on the ultrasonic receiver after net deployment, it was possible to estimate the time required for the net to reach the bottom; this was about 10 min for a depth of 160 m.

The maturity codes used in catch data tables are presented in Appendix Table B5a-B5b. Raw catch data from the 18 sets are presented in Appendix Tables B6 and B7. Fourteen commercially important species: 12 rockfishes, thornyheads Sebastolobus, and lingcod were caught in the eighteen gillnet sets (Table 3). In the 18 sets we caught 983 rockfishes, thornyheads and lingcod (Appendix Tables B6 and B7) from which we obtained

895 lengths, 409 weights, 496 sets of rockfish otoliths, and 100 lingcod fin rays. Other incidental species caught during the survey and discarded at sea included Pacific halibut, Hippoglossus stenolepis, Pacific cod, Gadus macrocephalus, ratfish, Hydrolagus colliei, dogfish, Squalus acanthias, white sturgeon, Acipensor transmontanus, turbot, Atheresthes stomias, and longnose skate, Raja rhina.

The lowest catch (mean 23.3 fish/set) and lowest number of species (mean 2.3 species/set) were obtained on smooth-bottom areas, whereas a greater catch (range 55.3-78.5 fish/set) and number of species (range 5.3-8.3 species/set) were obtained on pinnacles and deeper areas adjacent to the shelf dropoff (Table 4). For the catch/set summaries only, catches for nets cut in half (91 m to 45.5 m) were doubled with the assumption that their numbers would have been higher with a full length net.

The total catch from the 18 sets was dominated by four species: lingcod (23.4%), bocaccio (18.7%), yellowtail rockfish (15.9%), and canary rockfish (15.5%) (Table 5). The smooth habitat catch was dominated by lingcod, bocaccio, and yellowtail rockfish (Tables 2 and 4). The rough pinnacle catch was dominated by yellowtail rockfish, lingcod, bocaccio, and canary rockfish. The catch from the smooth areas above the shelf dropoff was dominated by canary rockfish, bocaccio, lingcod, sharpchin rockfish, silvergray rockfish, and widow rockfish. The catch from the shelf dropoff had the most speciose assemblage and was dominated by sharpchin rockfish, widow rockfish, redbanded rockfish, silvergray rockfish, canary rockfish, lingcod, bocaccio, and redstripe rockfish.

Length-frequency histograms are displayed for canary rockfish (Fig. 14), yellowtail rockfish (Fig. 15), and lingcod (Fig. 16). Mann-Whitney or Kruskal-Wallis tests, depending upon number of habitat comparisons, were used to test for differences between median lengths of fishes from each habitat type, when sample sizes were sufficiently large (>30 fish). Median lengths of canary rockfish were significantly smaller on the pinnacles when compared to the shelf dropoff and adjacent plateau ($p<0.05$). Lingcod were smaller on the smooth habitat when compared to the pinnacles alone ($p<0.05$) or a pooled sample of lingcod from the pinnacles, plateau, and shelf dropoff ($p<.01$).

Nets with the smaller mesh size (7.6 cm) caught a wider range of sizes of fish than those with the larger mesh size (15.3 cm). The small mesh net caught fish ranging in size between 154-1165 mm whereas the larger mesh net caught fish between 344-1210 mm. There was no significant difference in the median number of fish caught with the two mesh sizes when nets of similar length (91 m long) were compared (Mann-Whitney test, $p=0.67$). Thus, the smaller mesh net is adequate to catch a wide range of sizes and a similar number of fish when compared to the larger mesh.

Sets made during the daytime hours caught a similar number of fish and had a similar species composition to those made overnight, with the exception that widow rockfish were never caught in any daytime set regardless of habitat type (Table 3). A comparison of two daytime sets (Nos. 7 and 8) and two overnight sets (Nos. 10 and 15) made on a similar habitat type (Type 3 smooth plateau above shelf dropoff) detected no difference between the mean number of fish (of all species combined) caught per set (Anova $p=0.625$, $df=1$). Similarly, there was no difference in the number of species caught

between day (6.0 ± 2.0 species) (mean ± SE) and night (7.5 ± 2.5 species) (p=0.69). However, there was a high variability among sets made on the same habitat at the same time: the average catch/set was 92.5 ± 47.5 fish and 64.5 ± 22.5 fish for sets 7-8 and 10-15, respectively. On future cruises, more replicate sets are needed to determine whether these are true differences.

The 12 rockfish species caught were in a wide range of maturity stages from immature to recovering from a recent spawning (Appendix Table B6). Most yellowtail and canary rockfishes caught on pinnacles were immature: 40 of 51 (78%) canary rockfish and 83 of 137 (61%) yellowtail rockfish were stage 1. All but four of the 230 lingcod caught were females; most female lingcod were spent or recovering.

Hydroacoustic observations of the fish schools detected a diel difference in their associations with the bottom; at night the fish schooled above and off the bottom, whereas during the day they dispersed. Some rockfish may have been adjacent to the bottom where hydroacoustic measurements are not effective. Our daytime gillnet sets caught rockfish, suggesting that some fish might drop to the bottom during the day, rather than leave the pinnacles. The lack of widow rockfish from daytime sets suggests that after their nighttime associations they either move away from the bottom or move close to the bottom and become inactive. In either case, they may be unavailable to gillnets during the day. Wilkins (1986) noted that widow rockfish were unavailable to bottom trawls in areas where they typically aggregate at night. He concluded that it was unlikely that widow rockfish disperse along the bottom during the day.

When retrieved, gillnet sets 16 and 17 had collapsed floats. It is likely that the depths to which the nets were subjected (up to 200 m) caused the floats to lose their buoyancy. The lack of buoyancy could cause the float line to sink onto the lead line. If so, the net would not have been fishing properly and this may account for the low catches in sets 16 and 17. When sets 16 and 17 were removed from the rough pinnacle summary (Table 4) the average catch/set increased to 86.6 ± 19.1 fish (compared to 72.9 ± 17.5 fish) and the mean number of species/set increased to 6.2 ± 0.4 species (compared to 5.3 ± 0.7 species). Future use of sunken gillnets in deep water requires that the floats withstand the increased pressure without collapsing; hard plastic or wooden floats may be effective.

Off Brooks peninsula, we were unable to locate untrawlable hard-bottom and adjacent smooth-bottom areas deeper than 200 m, where Pacific Ocean perch would typically be found. Thus, we could not compare the species composition of deepwater communities of trawlable and untrawlable areas that would have a slope rockfish assemblage (i.e., Pacific ocean perch, yellowmouth rockfish, rougheye rockfish). Future research cruises will need to locate and fish in deeper hard-bottom areas to make this comparison.

Although sunken gillnets are labor intensive and produce relatively low and variable catches, they catch a variety of commercially important species with a minimum of gear loss, and thus, are effective for sampling the species composition of hard and smooth-bottom habitats. The catches are also useful for species identification of hydroacoustic

observations. It would be helpful, with the use of video cameras, to determine which species are not caught by the net and the position of the net on the bottom. There may be some bias in species attraction to sunken gillnets, causing the catch to be overrepresented by piscivorous fish; lingcod and bocaccio were often found in the nets with fresh rockfish still in their mouth, apparently attracted to the nets by the recently caught rockfish. With some modifications to sunken gillnet design and increased replication, gillnets will be a useful tool to compare the species composition of untrawlable and trawlable areas.

ACKNOWLEDGMENTS

We would like to thank Captain John Anderson and the crew of the CSS JOHN P. TULLY for their valuable assistance. Jim Parks of the Institute of Ocean Sciences ventured with us on the JOHN P. TULLY, and his technical advice saved us from disaster on several occasions. Rick Thomson and Joe Linguanti of IOS graciously made the current, salinity and temperature vector plots. We would also like to thank Frank Ross, the skipper of the VELMA C for his hard work, patience, and good humor. We appreciate the help of Whitey Rendernick, a commercial fisherman from California, who assisted us with the design of the sunken gillnets.

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Table 1. Transect numbers, number of replications, start and finish times and dates, transducer frequency, mean transect time, transect length, data status, and data storage medium for hydroacoustic observations in Brooks Bay.

TRANSECT	NO. OF REPS	START/FINISH TIME DATE	TRANSDUCER FREQ. (KHZ)	EXPOSE TIME (h)	TRANSECT LENGTH (nm)	ECHO INTEGRATION	STORAGE MEDIUM
T1-11	2	0927 15/03 -0239 16/03	38	6	6	yes	DAV
C1	1	0916-1135 16/03	38	2.5	15	yes	DAV
C2	1	1146-1306 16/03	38	1.25	10	yes	DAV
C3	1	1320-1533 16/03	38	2	9	yes	DAV
A1-4	18	1819 16/03 -0859 18/03	38	2	3	yes	DAV
A3-4	7	1122-0119 19/03	120	1	3	no	HP
F1-2	23	1531 19/03 -0827 20/03	120	0.5	1.5	no	HP
G3-4	24	2057 20/03 -0757 21/03	120	0.5	1.25	no	HP
H1-2	20	1827 21/03 -0711 22/03	120	0.5	1.5	no	HP

Table 2. Biomass estimate (t) and biomass centroid (m from bottom) for day and night repetitions of transects T1-T11.

TRANSECT	DAY		NIGHT	
	Biomass	Biomass centroid	Biomass	Biomass centroid
T 1	450	11.5	332	33.1
T 3	386	15.4	857	8.6
T 5	208	7.2	288	17.1
T 7	345	2.0	277	16.0
T 9	260	77.8	214	66.3
T11	217	25.5	80	39.0
TOTAL	1870		2050	
MEAN		23.2		30.0

Table 3. A summary of the species composition, time of set (N=overnight, D=daytime), number of fish caught, and the number of species caught for sunken gillnet sets 1-19 made from March 16-23, 1989, in Brooks Bay. Bottom type abbreviations are: 1= Smooth >100 m, 2= Rough pinnacle 95-130 m, 3= Smooth, above shelf dropoff >170 m, 4= Shelf dropoff >170 m.

Set No.	1	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	
Bottom type	1	2	2	1	1	3	3	4	3	2	2	2	4	3	2	2	4	4	
Species																			Total
Sebastes babcocki							1	3	4				8				2	4	22
S. brevispinus		1				1	17	1	8	1			12	2			3	1	47
S. elongatus									1			2							3
S. entomelas								10	25	1							16	5	57
S. flavidus	11	4	54						3	5	60	14					3	2	156
S. helvomaculatus			9				2				2		3	2	2	3		3	26
S. maliger																1			1
S. paucispinus		64	9	11	4	2	45	1	7	15	8	4	10	4					184
S. pinniger		12	7		1	26	17	2	30	1	3	1	3	11	3	24	4	7	152
S. proriger								2	1								9		12
S. ruberrimus		1	1				3			1	1							1	8
S. zacentrus			1				37	18	2				12				11	2	83
Sebastolobus								2											2
Ophiodon elongatus	2	65	13	13	28	16	18	6	6	6	24	13	6	2		8	3	1	230
Totals No. of fish	13	147	94	24	33	45	140	45	87	30	98	34	54	21	5	36	51	26	983
No. of species	2	6	7	2	3	4	8	9	10	7	6	5	7	5	2	4	8	9	14
Bottom type	1	2	2	1	1	3	3	4	3	2	2	2	4	3	2	2	4	4	
Time of set	N	N	N	D	D	D	D	N	N	N	D	N	N	N	D	D	N	N	
Net length- 1= 91 m 0.5= 45.5 m	1	1	1	1	1	1	1	0.5	1	0.5	1	1	1	0.5	1	0.5	0.5	1	

Table 4. A summary of the mean number of fish, mean number of species caught, and dominant species (5% of total catch for that habitat type) for sets 1-19.

Habitat type	Mean # fish/set ± SE	Mean # species/set ± SE	Dominant species
Smooth 100-175 m n=3	23.3 ± 5.8	2.3 ± .3	LC, BOC, YT
Rough pinnacle 95-130 m n=7	72.9 ± 17.5	5.3 ± 0.7	YT, LC, BOC, CAN
** remove sets Nos. 16-17 n=5	86.6 ± 19.1	6.2 ± 0.4	YT, LC, BOC, CAN
Smooth, above shelf dropoff 170-185 m n=4	78.5 ± 22.9	7.8 ± 1.0	CAN, BOC, LC, SC, SG, WID
Shelf dropoff 170-201 m n=4	55.3 ± 13.2	8.3 ± 0.5	SC, WID, BAB/SG, CAN/LC, BOC/RS

Table 5. A summary of the species composition as a proportion of each set and total catch.

Set / Species	Proportion by set																	Proportion of total catch
	1	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	
Sebastes babcocki								0.06	0.04				0.14				0.03	0.15	0.022
S. brevispinus						0.02	0.12	0.02	0.09	0.03			0.22	0.09			0.05	0.03	0.048
S. elongatus									0.01			0.05							0.003
S. entomelas								0.22	0.28	0.03							0.31	0.19	0.058
S. flavidus	0.84	0.02	0.57						0.03	0.16	0.61	0.41					0.05	0.07	0.159
S. helvomaculatus			0.09				0.01				0.02		0.05	0.09	0.40	0.08		0.11	0.026
S. maliger																0.02			0.001
S. paucispinus		0.43	0.09	0.45	0.12	0.04	0.32	0.02	0.08	0.50	0.09	0.11	0.18	0.19					0.187
S. pinniger		0.08	0.07		0.03	0.57	0.12	0.04	0.34	0.03	0.03	0.02	0.05	0.52	0.60	0.66	0.07	0.26	0.155
S. proriger								0.04	0.01								0.17		0.012
S. ruberrimus		0.01	0.01				0.02			0.03	0.01							0.03	0.008
S. saxatrus			0.01				0.26	0.40	0.02				0.22				0.21	0.07	0.084
Sebastolobus								0.04											0.002
Ophiodon elongatus	0.15	0.44	0.13	0.54	0.84	0.35	0.12	0.13	0.06	0.20	0.24	0.38	0.11	0.09		0.22	0.05	0.03	0.236

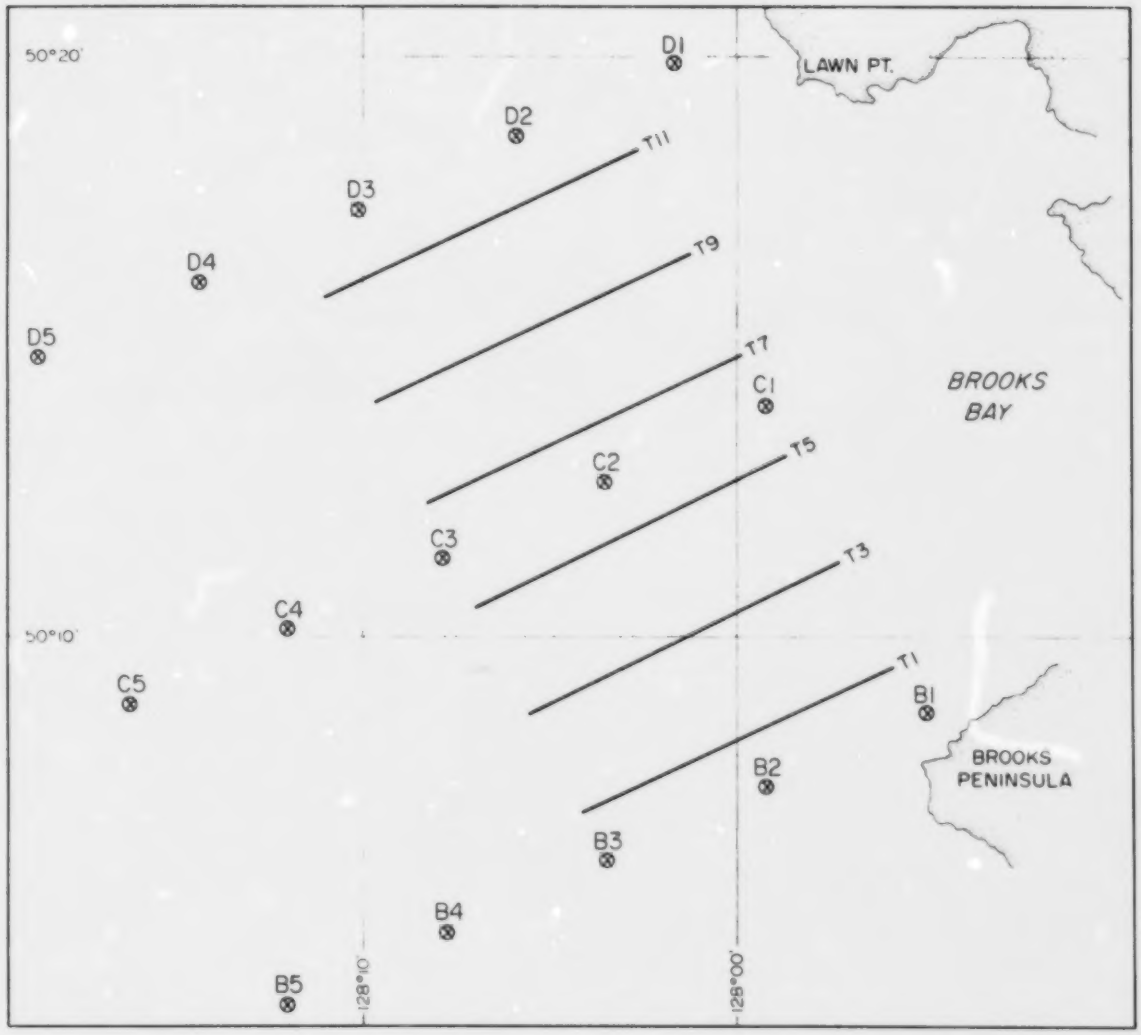
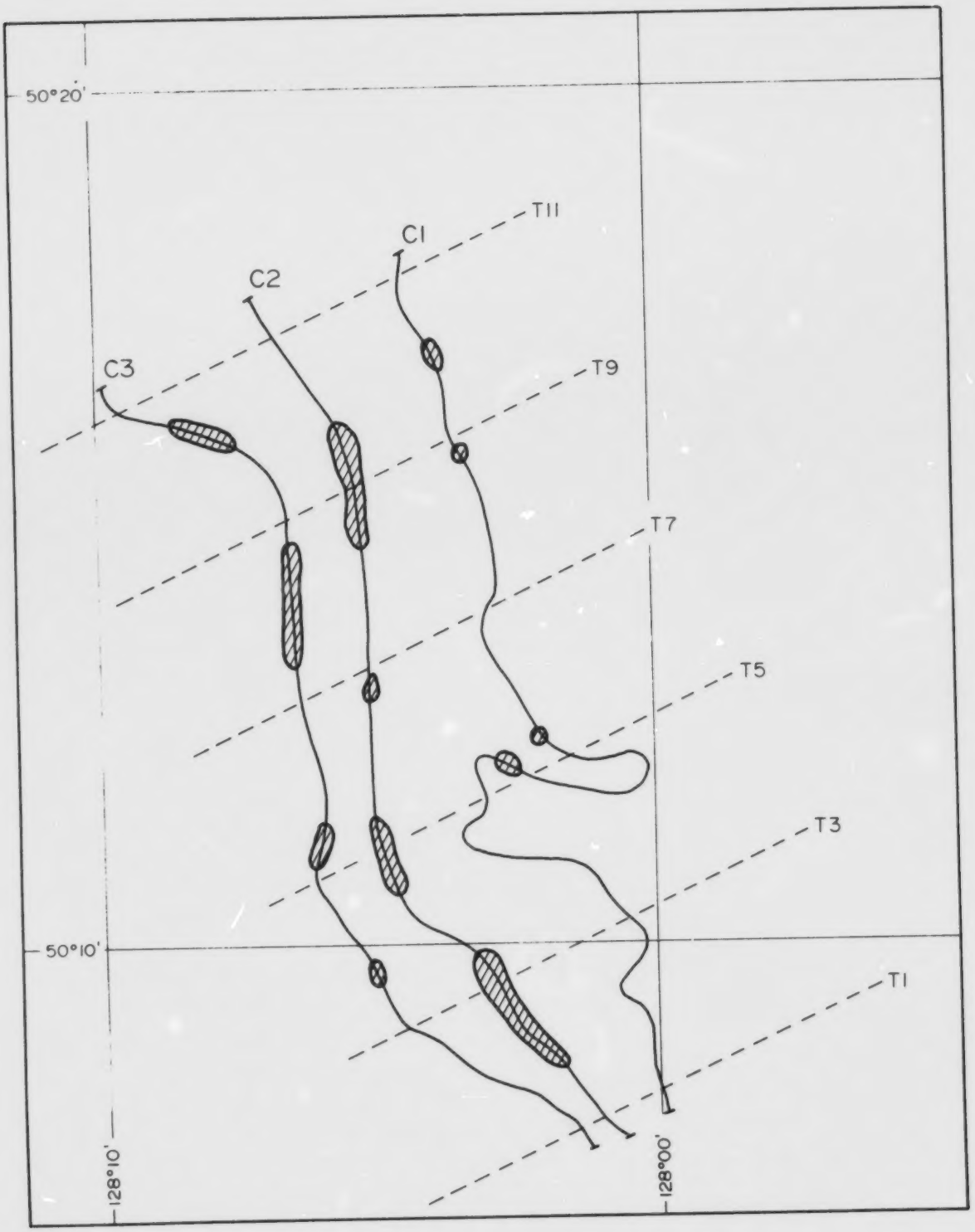


Fig. 1. Location of hydroacoustic transects T1-11 and STD stations in Brooks Bay.

Fig. 2. Location of hydroacoustic transects C1, C2, and C3 following the 90, 140, and 200 m contours, respectively (solid lines). The location of transects T1-11 is indicated for reference (dotted lines). Hatched areas indicate the presence of fish schools.


50°20'
50°10'
128°10'
128°00'
C1
C2
C3
T11
T9
T7
T5
T3
T1

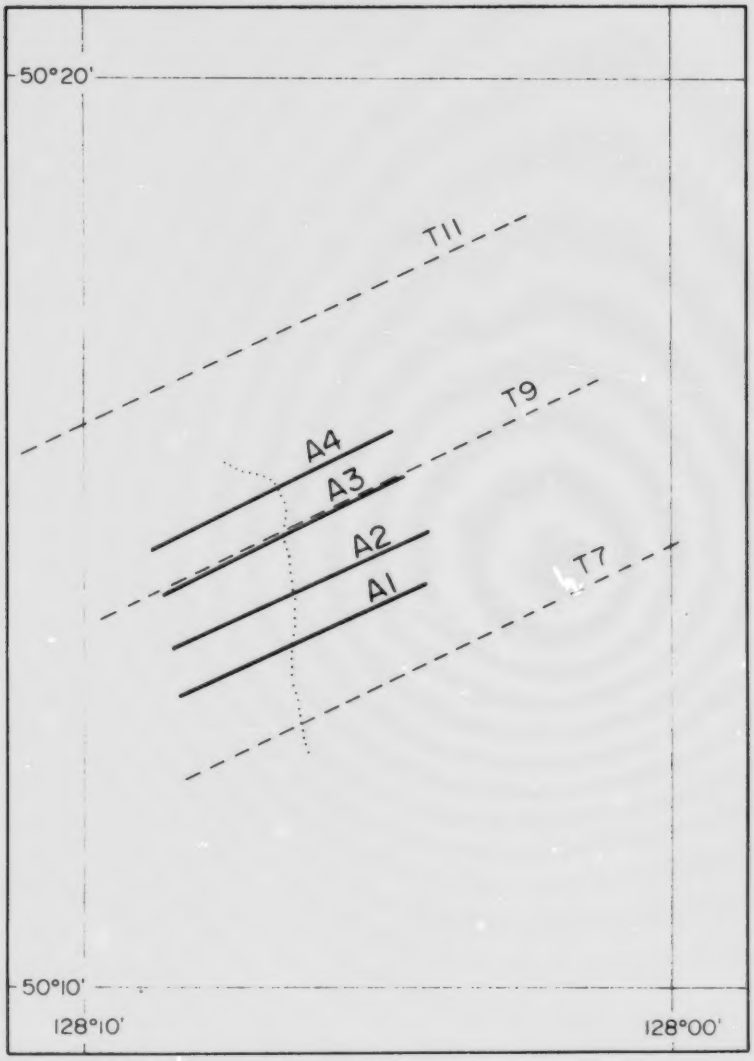


Fig. 3. Location of hydroacoustic transects A1-4 (solid lines). The location of transects T7-11 is indicated for reference (dashed lines). The 200 m contour is denoted by the dotted line.

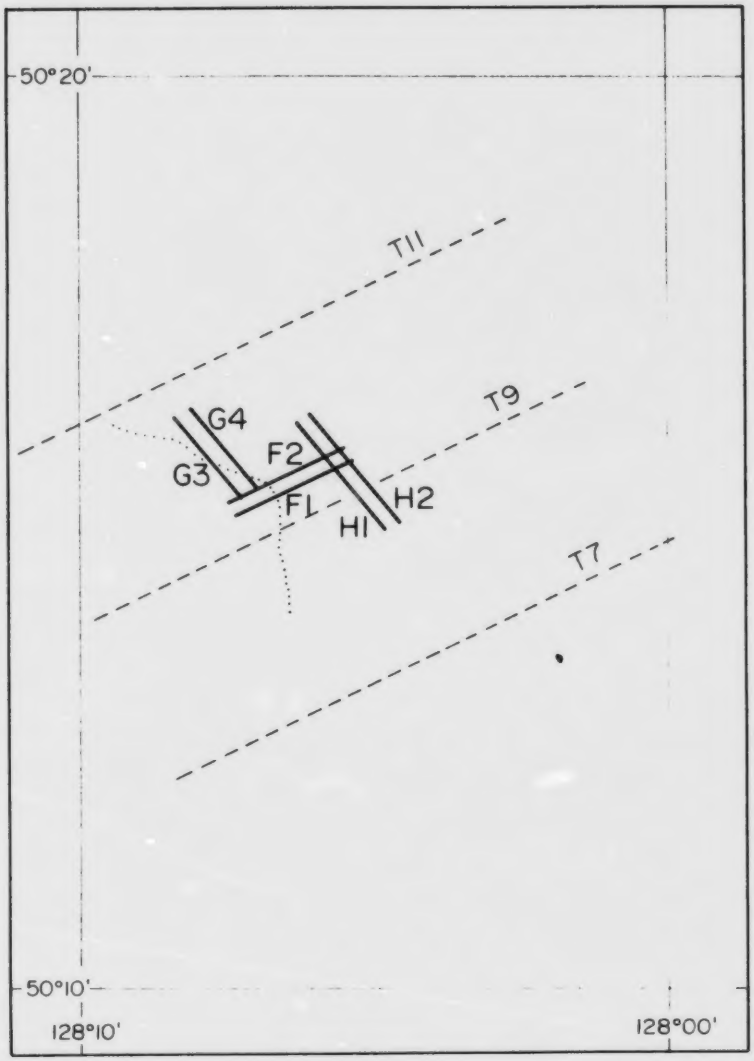


Fig. 4. Location of hydroacoustic transects F1-2, G3-4, and H1-2 (solid lines). The location of transects T7-11 is indicated for reference (dashed lines). The 200 m contour is denoted by the dotted line.

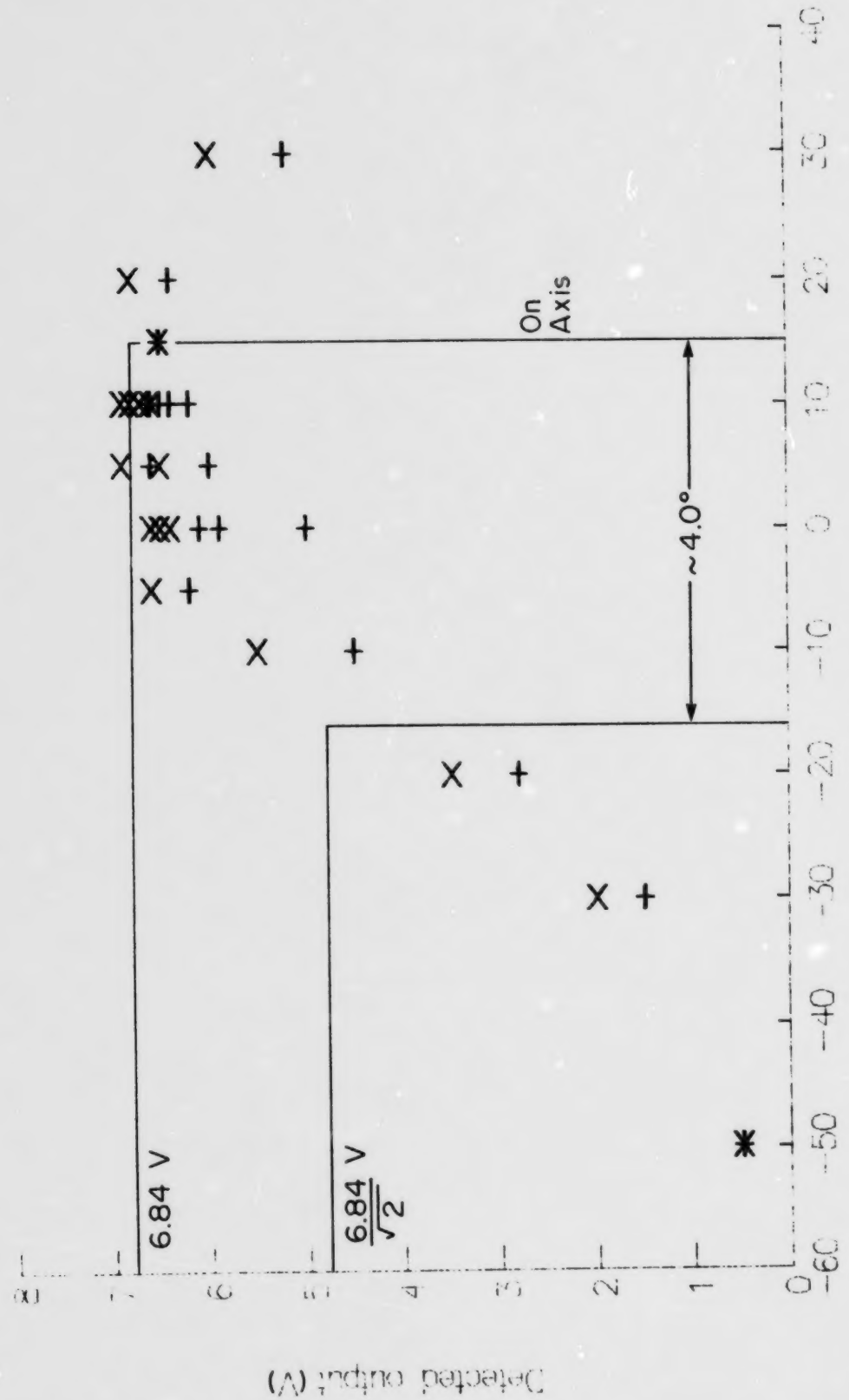


Fig. 5. Standard target calibration results for the 38 kHz transducer. The echo voltage is plotted against angle from the acoustic axis. The curve reflects the transducer beam pattern.

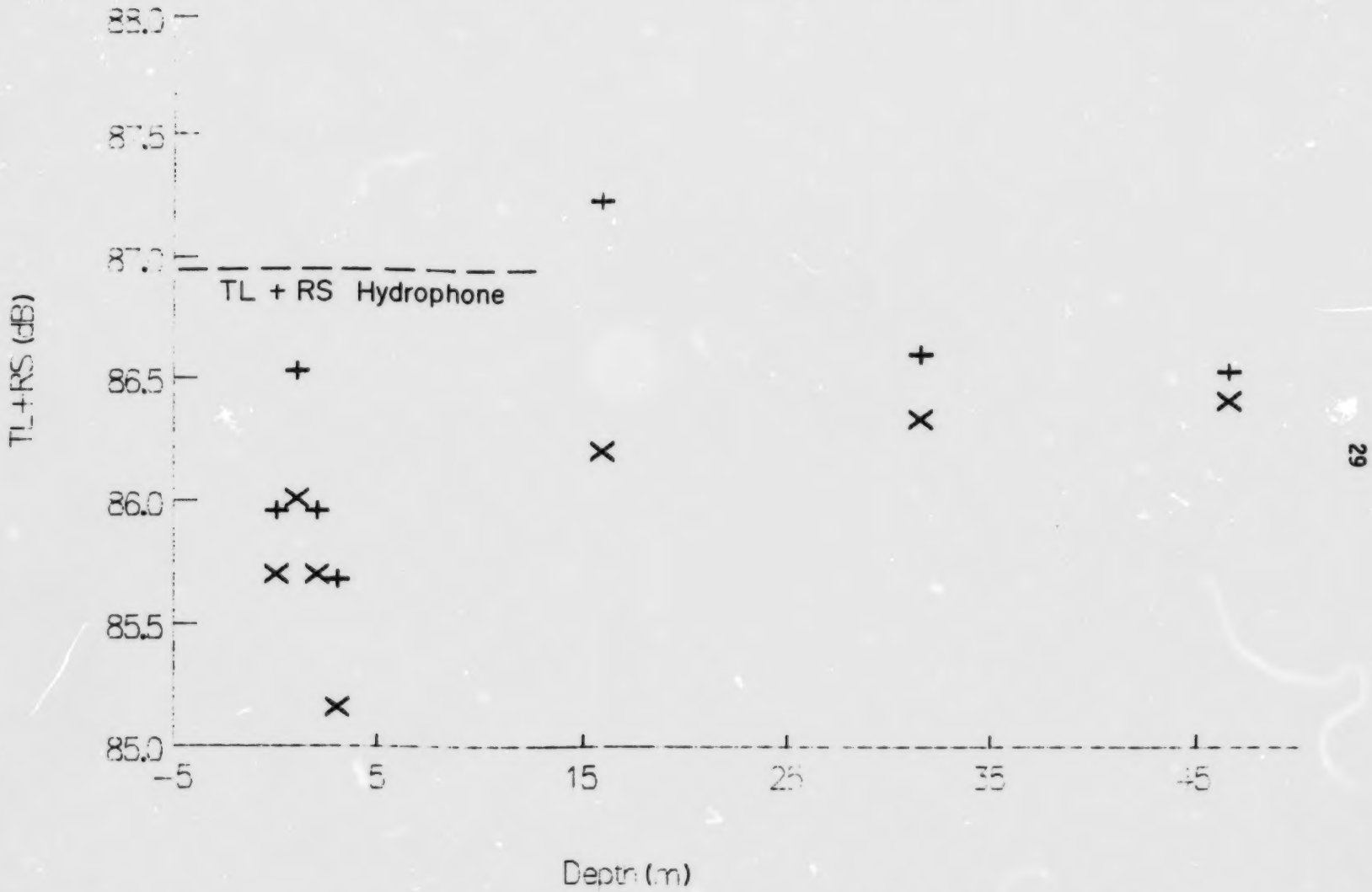


Fig. 6. Results from 38 kHz target calibration for several transducer depths. The eight measurements at the left were made at 1-m depth. The target was 5.74 m from the transducer.

Fig. 7. Results from 120 kHz target calibration for several depths. The eight measurements at the left were made at 1-m depth. The target was 6.15 m from the transducer. The data from the narrow and wide beam are given by + and x, respectively.

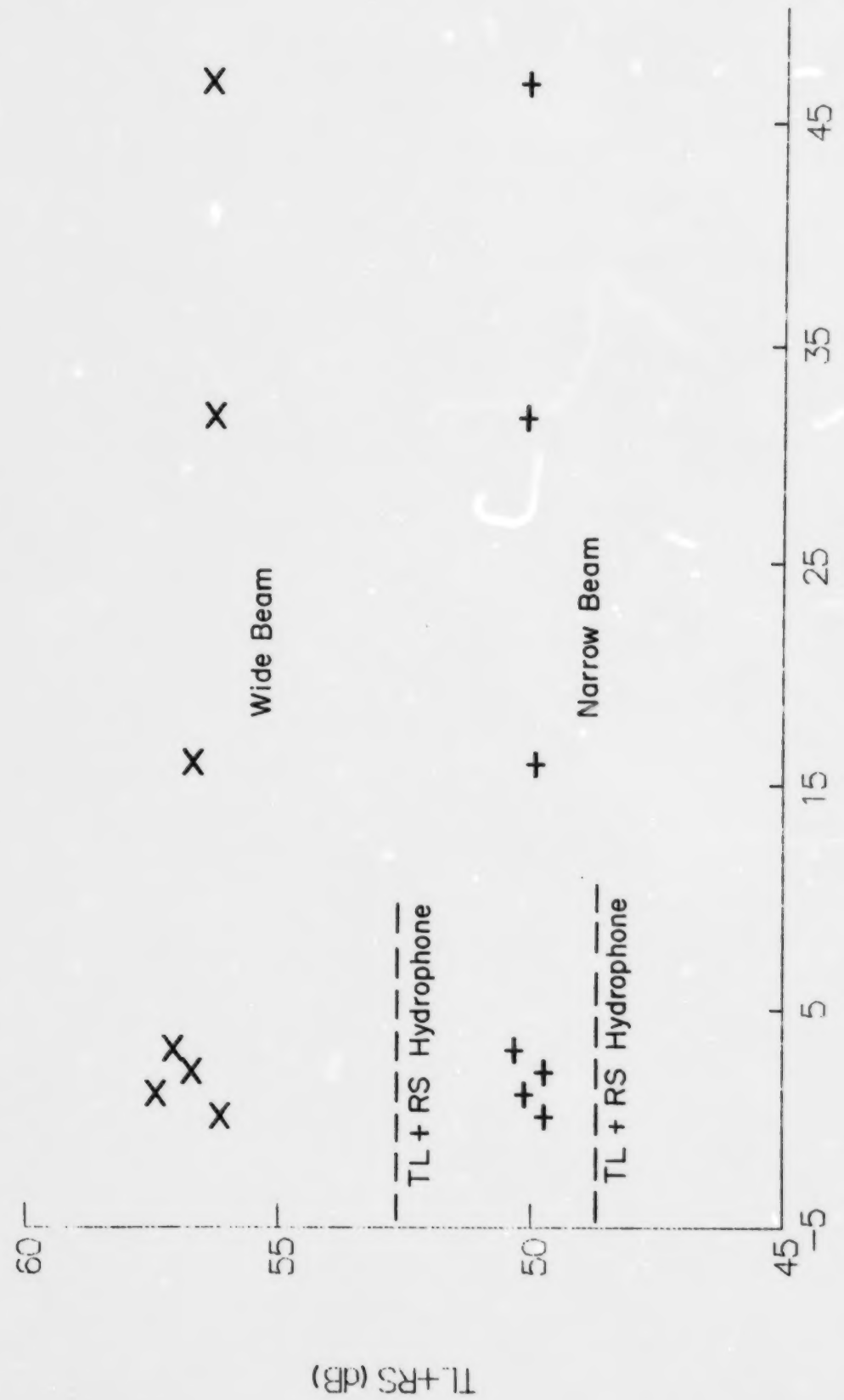
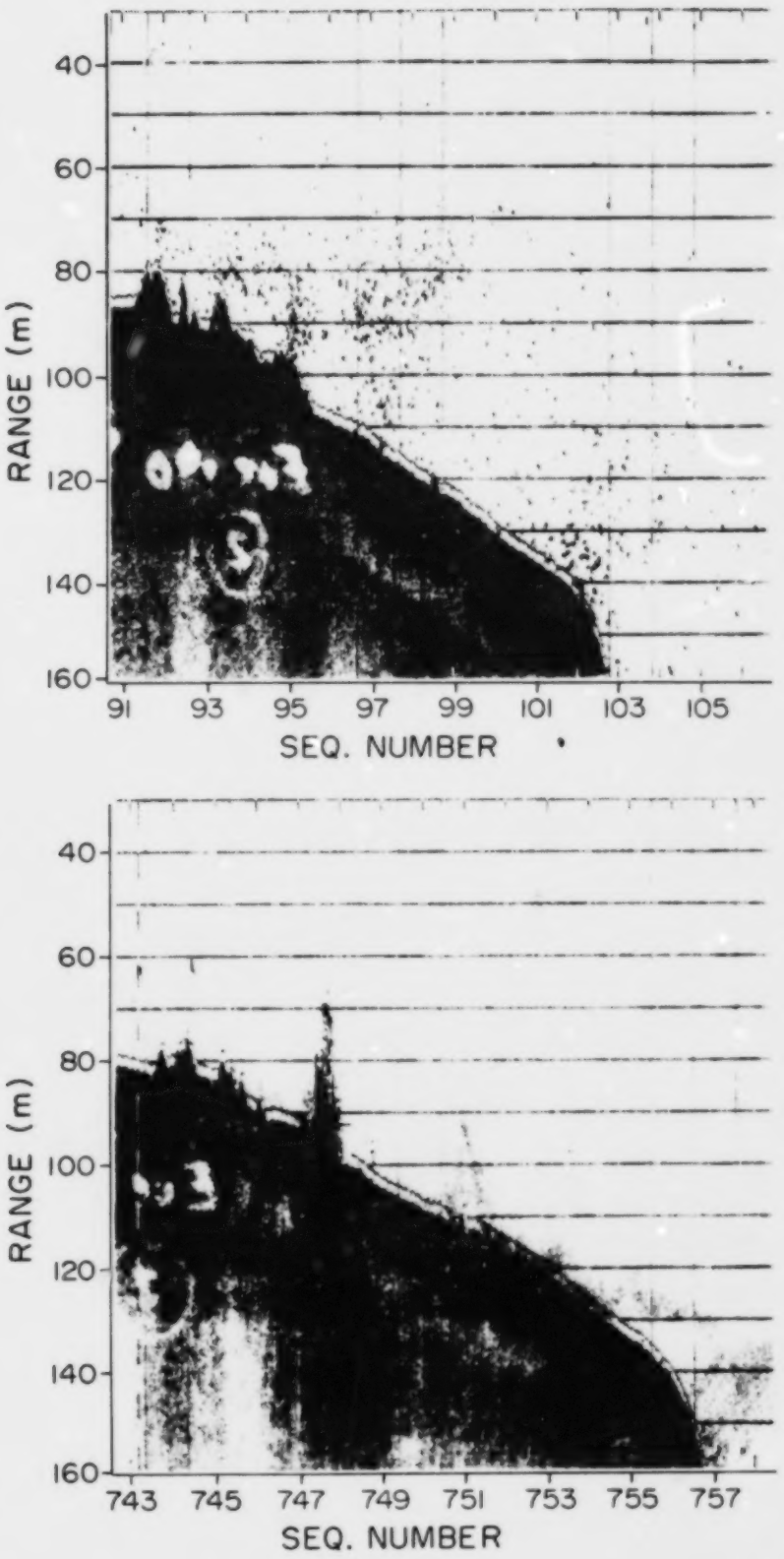

TL+RS (dB)
60
55
50
45
-5
5
15
25
35
45
Depth (m)
Wide Beam
Narrow Beam
TL + RS Hydrophone
TL + RS Hydrophone

Fig. 8. Echogram for transect A1 using the 38 kHz transducer at 20 log R. (A, top) Nighttime distributions, March 16 from 2018 h -2035 h. (B, bottom) Daytime fish distributions, March 17 from 0722-0745 h.


40
60
80
100
120
140
160
RANGE (m)
91
93
95
97
99
101
103
105
SEQ. NUMBER
40
60
80
100
120
140
160
RANGE (m)
743
745
747
749
751
753
755
757
SEQ. NUMBER

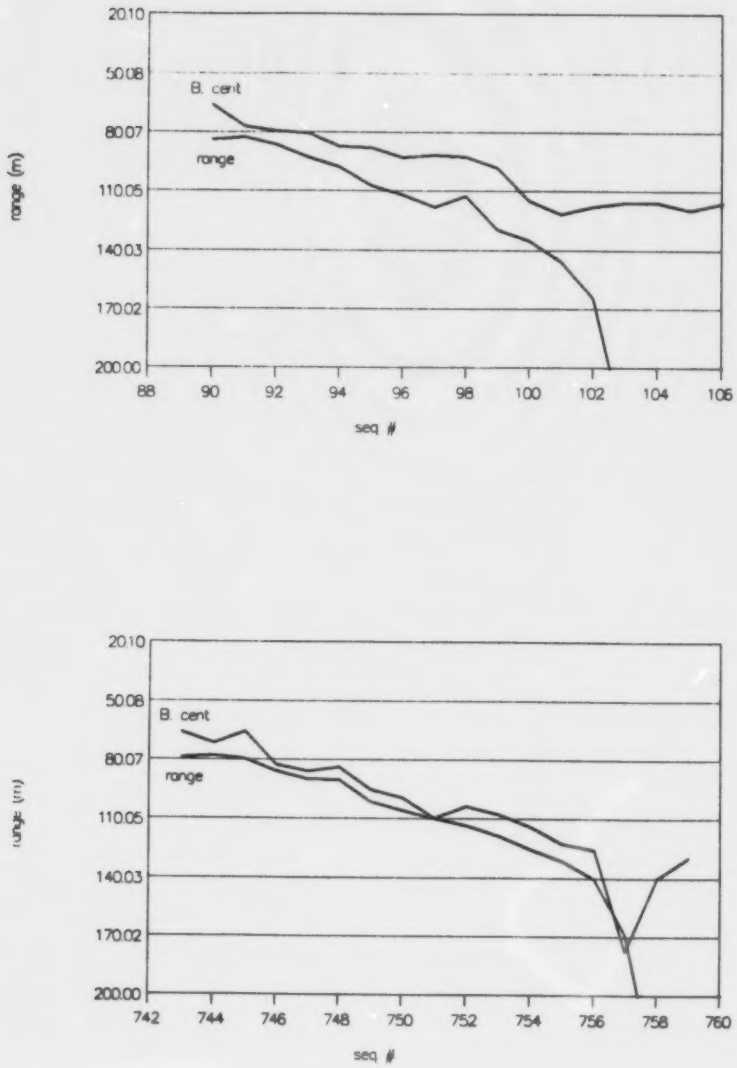


Fig. 9. Biomass centroid and the range from the transducer to bottom for transect A1. (A, top) March 16, 2018-2035 h. (B, bottom) March 17, 0722-0745 h.

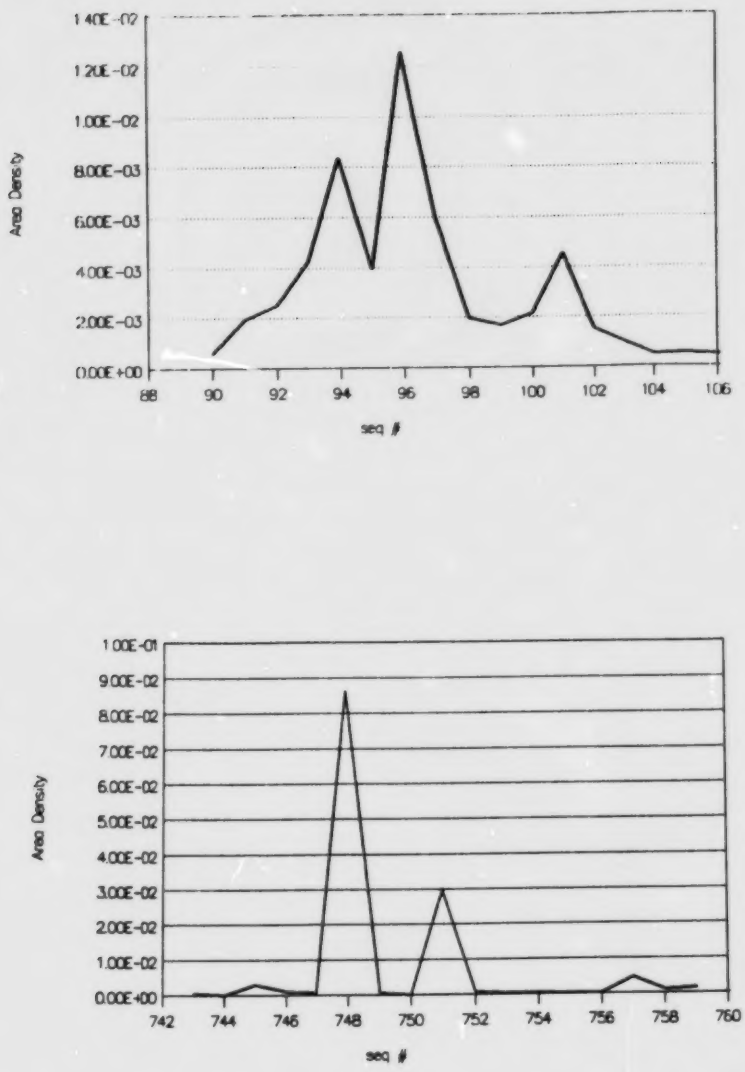


Fig. 10. Biomass estimates for transect A1. (A, top) March 16, 2018-2035 h. (B, bottom) March 17, 0722-0745 h.

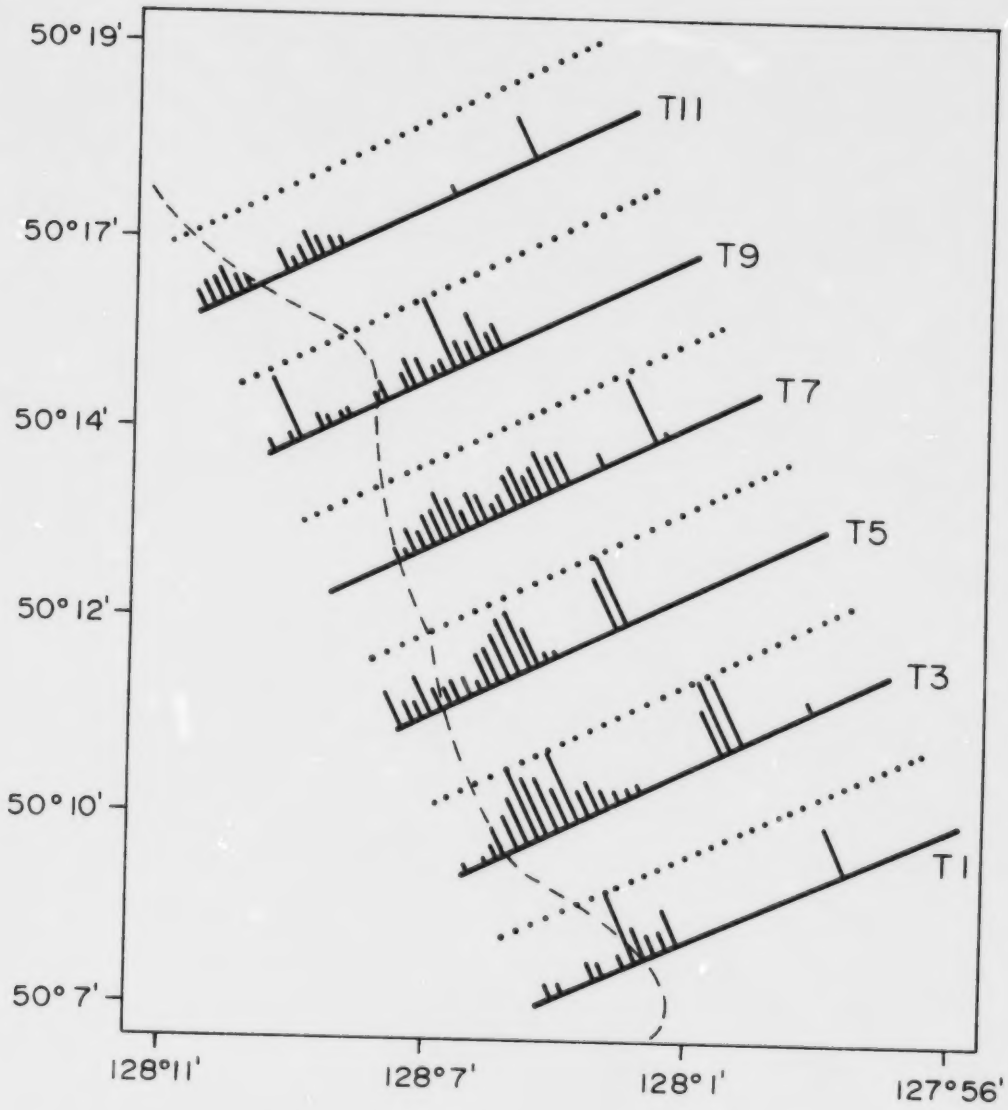


Fig. 11. Fish densities along transects T1-11 over 50-150 m. Density is on a log scale from 0.001-0.100 kg/m^2. The 200 m contour is denoted by the dashed line. (A) Nighttime densities, March 16, 2029-0239 h.

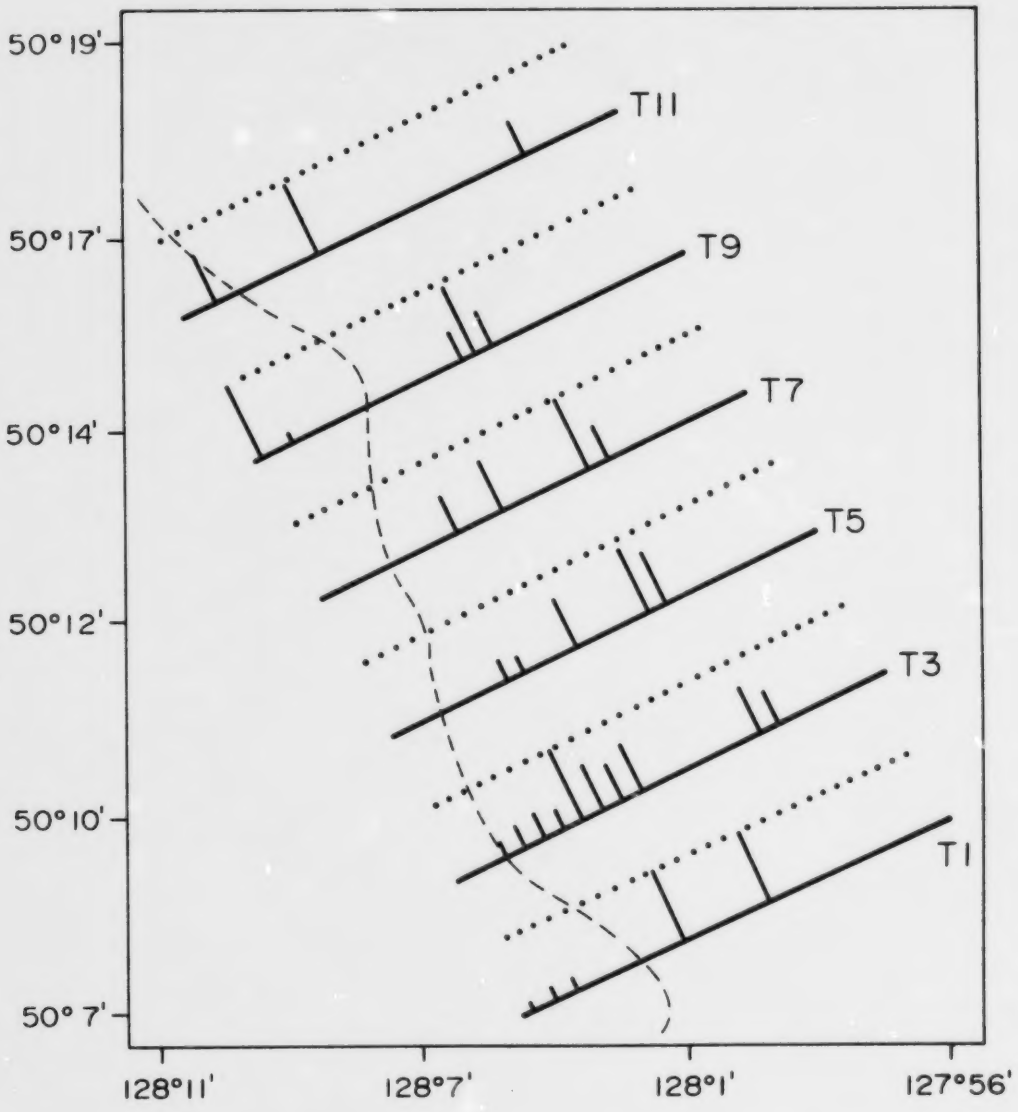


Fig. 11B. (B) Daytime densities, March 15,0927-1547 h.

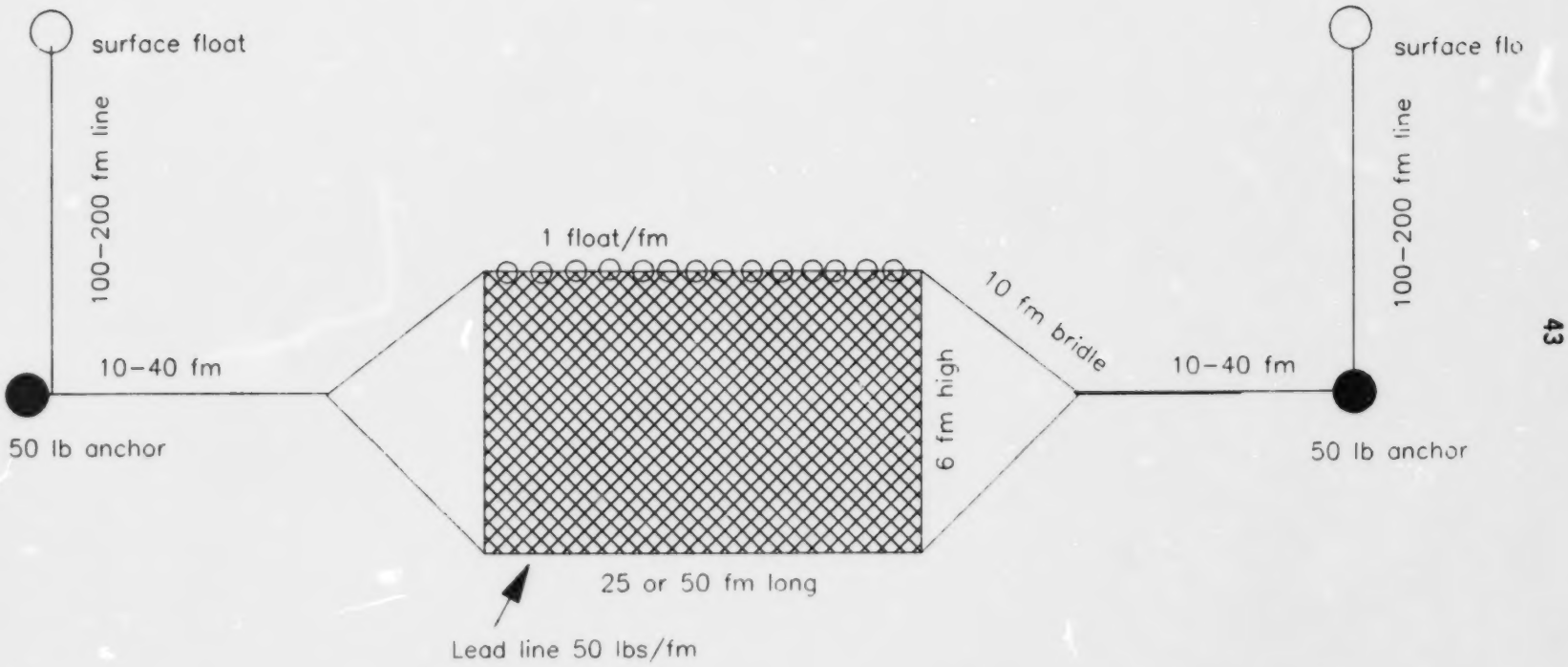


Fig. 12. Specifications of sunken gillnet.

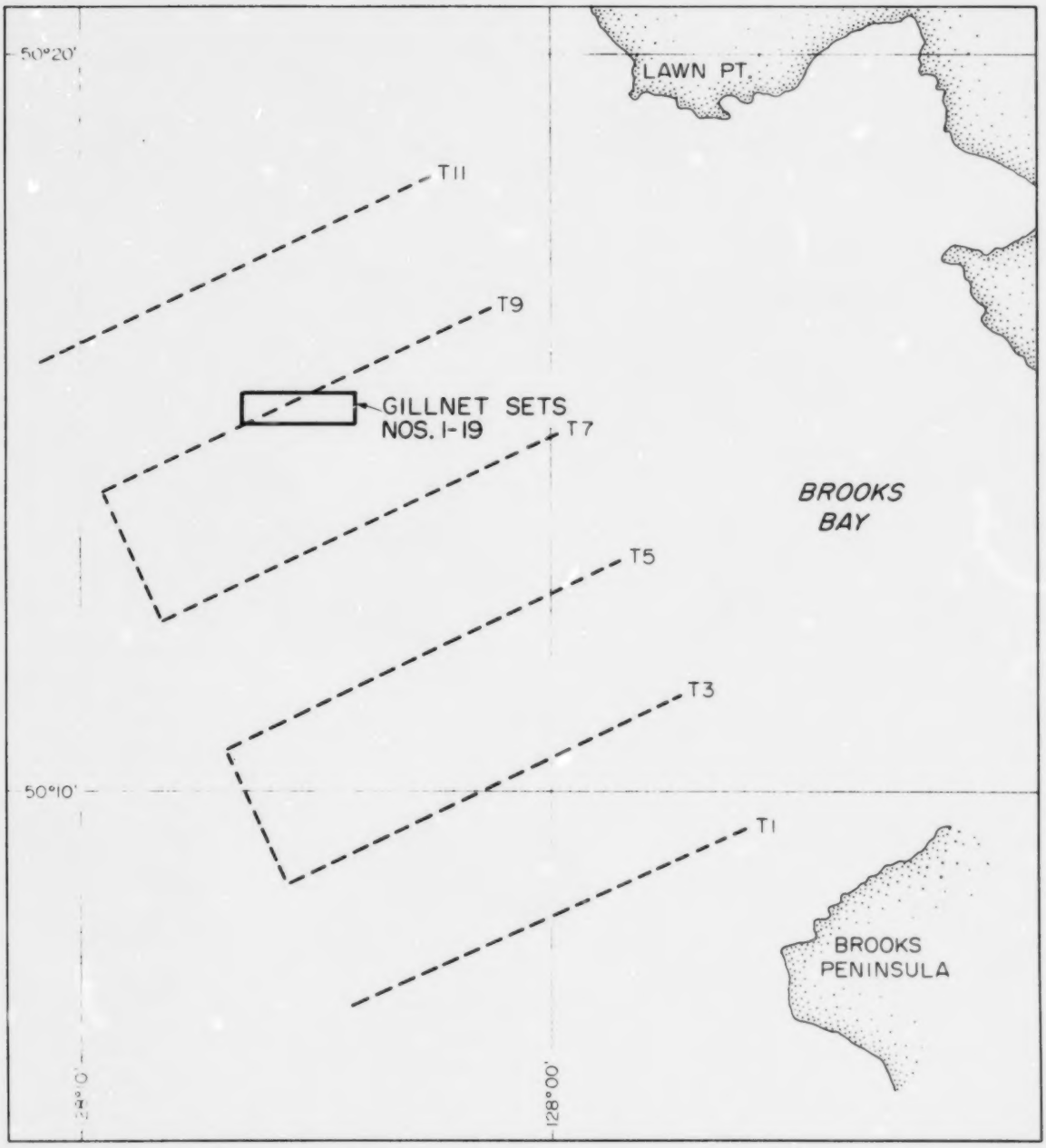


Fig. 13. Relative locations of gillnet sets 1-19 of Brooks Peninsula.

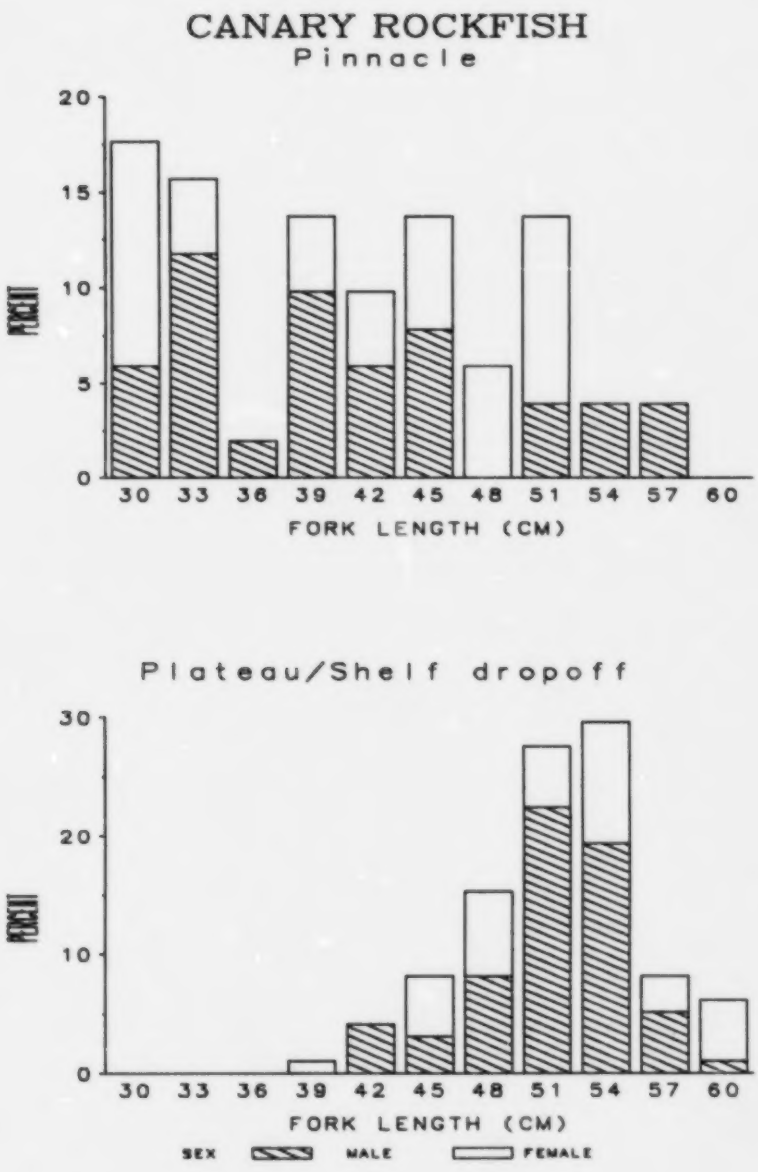


Fig. 14. Length-frequency histograms by sex and habitat type for canary rockfish. Length (cm) is the midpoint for the size interval.

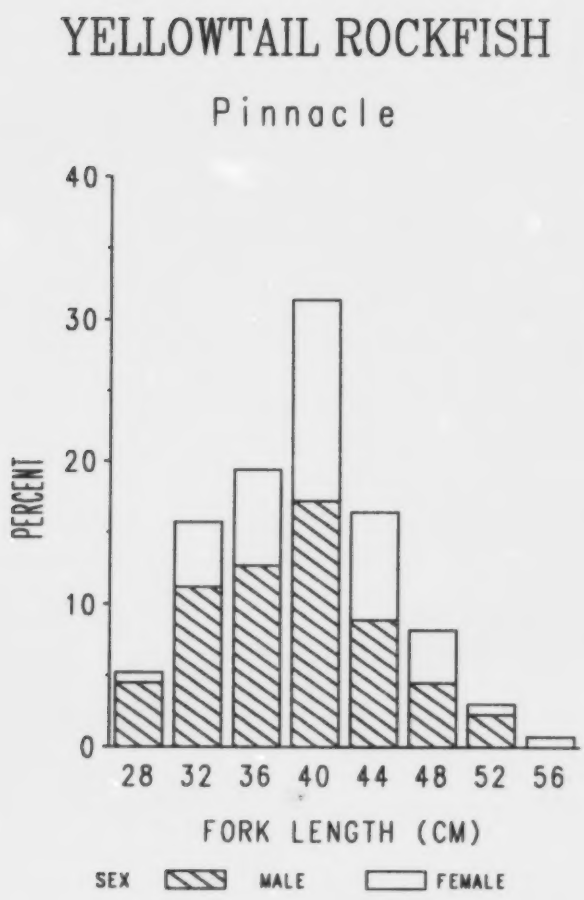


Fig. 15. Length-frequency histograms by sex for yellowtail rockfish on the pinnacle habitat. Length (cm) is the midpoint for the size interval.

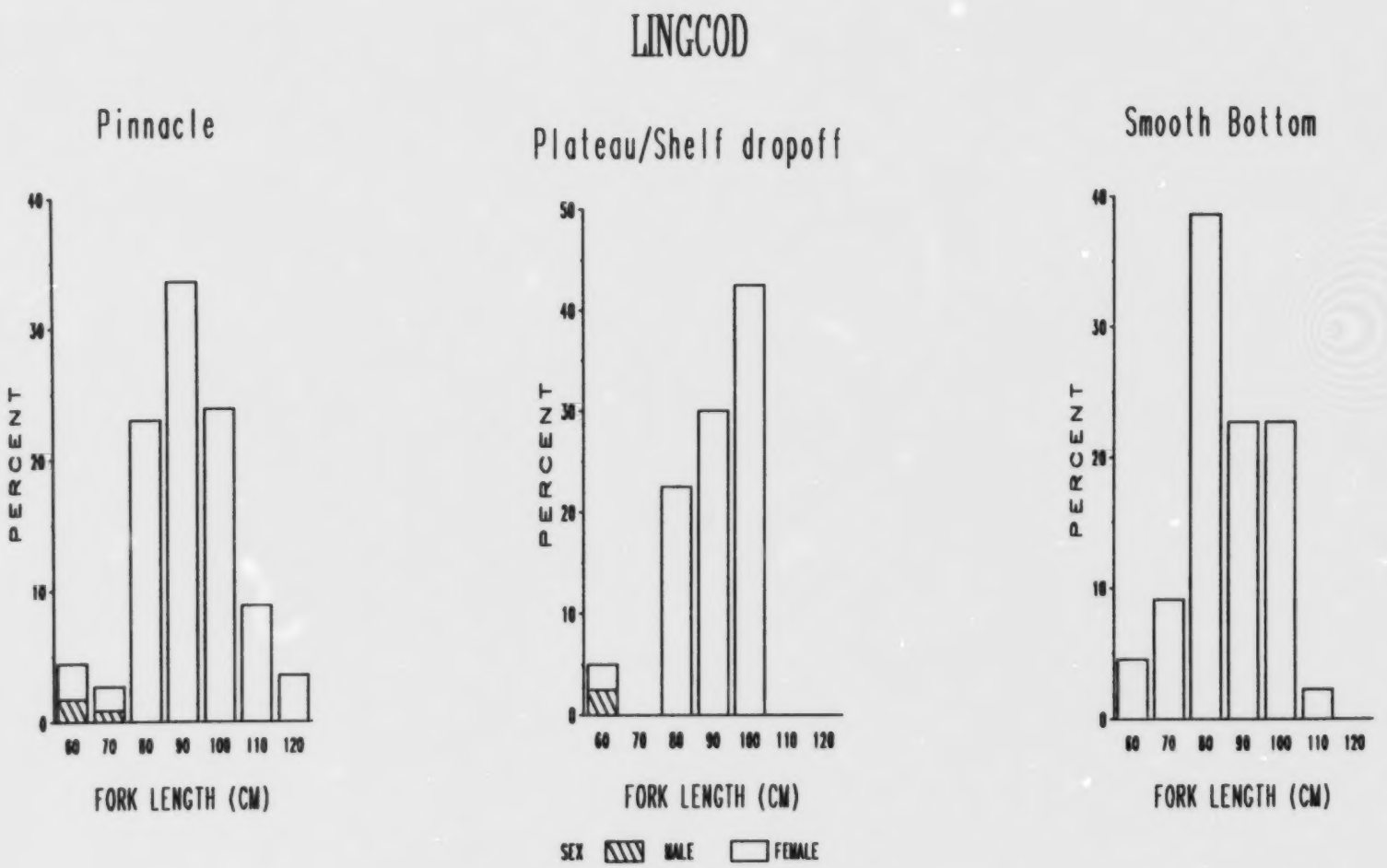


Fig. 16. Length-frequency histograms by sex and habitat type for lingcod. Length (cm) is the midpoint for the size interval.

APPENDIX A

Appendix Table A1. Hydrophone calibration for 38 kHz single beam acoustic system.

Echo Sounder Calibration Date: 21 February 1989
Place: APL, U. of Washington
Persons: G. McGlassen, J. Candy

A. GENERAL

Echo Sounder Model: BioSonics 101 Ser#: 101-85-049 Fre. kHz: 38

Cable #	Description	Date	Length m	DC Res ohms
1	ES to deck	1986	~6	0.4
2	Deck	1986	~30	2.4
3	Armored tow	1984	~60	4.7

Transducer	Year	Mod	Ser#	Use	FWHM deg
Simrad 38 kHz	1980	38-26/22-E	S4318	Towed body	8.1x13.3

Standard Hydrophone Model: F-41 Ser#: 121
TL dB uPa/Vrms at 1 m: 127.8 RS dB Vrms/uPa: -206.0

Tank parameters
Hydrophone/Transducer separation m: 6.0 Salinity: 0 Temp deg: 5.5

B. ECHO SOUNDER BENCH TEST

Bandwidth kHz : 5.0 Alpha dB/m : 0.0099
Cal Pulsed/CW : PUL Separation m : 10
Trig interval s: 0.5 Blanking r1 r2 m: 3-500
Pulse width ms : 0.6

Resistive load/attenuator Ohms: 55 Year: 1985

Xmit power dB: 0 Res. load out Vpp: 5.55

Receiver-Gain TVG	dB	R m	Cal dB	Chan 1 Det V	Chan 2 Det V
20 log R	0	30	-6	5.9	6.2
40 log R	0	30	-6	3.9	3.8

Appendix Table A1 (cont'd)

C. TRANSMIT LEVEL - HYDROPHONE CALIBRATION

Cable #	Xmit dB	TL dB uPa 1m
1+2	0	221.2

D. RECEIVE SENSITIVITY - HYDROPHONE CALIBRATION

Rec gain dB : -6
Bandwidth kHz : 5.0
Cal : Off
Trig interval s: 0.5
Rec TVG range m : 30
Alpha dB/m : 0.0099
Blanking range m: Off
Pulse width ms : 0.6

Cable #	Receiver-Gain TVG	m	dB	RS Chan1 dB Vdet/uPa	RS Chan2 dB Vdet/uPa
1+2	20 log R	1	0	-133.36	...
1+2+3	20 log R	1	0	-133.56	...

Appendix Table A2. Hydrophone calibration for 120 kHz dual beam acoustic system.

Echo Sounder Calibration Date: 21 February 1989
Place: APL, U. of Washington
Persons: G. McGlassen, J. Candy

A. GENERAL

Echo Sounder Model: BioSonics 101 Ser#: 101-79-002 Fre. kHz: 120

Cable #	Description	Date	Length m	DC Res ohms
1	ES to deck	1986	~6	0.4
2	Deck	1986	~30	2.4
3	Armored tow	1984	~60	4.7

Transducer	Year	Mod	Ser#	FWHM deg
BioSonics 120 kHz	1987	Dual beam	26-120-1025-020	9.4, 24.3

Standard Hydrophone Model: F-41 Ser#: 121
TL dB uPa/Vrms at 1 m: 151.8 RS dB Vrms/uPa: -203.3

Tank parameters:
Hydrophone/Transducer separation m: 6.0 Salinity: 0 Temp deg: 5.5

B. ECHO SOUNDER BENCH TEST

Bandwidth kHz : 5.0 Alpha dB/m : 0.0369
Cal Pulsed/CW : PUL Separation m : 10
Trig interval s: 0.5 Blanking r1 r2 m: 3-500
Pulse width ms : 0.6

Resistive load/attenuator Ohms: 55 Year: 1979

Xmit power W: 1000 Res. load out Vpp: 5.50

Receiver-Gain TVG	dB	R m	Cal dB	Chan 1 Det V	Chan 2 Det V
20 log R	2x6	30	0	2.20	2.45
40 log R	2x6	30	0	0.63	0.73
20 log R	2x6	100	0	1.28	1.50
40 log R	2x6	100	0	1.26	1.49

Appendix Table A2 (cont'd)

C. TRANSMIT LEVEL - HYDROPHONE CALIBRATION

Cable #	Xmit W	TL dB uPa 1m
1+2	1000	219.2
1+2+3	1000	218.9

D. RECEIVE SENSITIVITY - HYDROPHONE CALIBRATION

Rec gain dB : 2x6, 3x6
Bandwidth kHz : 5.0
Cal : Off
Trig interval s: 0.5
Rec TVG range m : 30
Alpha dB/m : 0.0369
Blanking range m: Off
Pulse width ms : 0.6

Cable #	Receiver-Gain TVG	m	dB	RS Chan1 dB Vdet/uPa	RS Chan2 dB Vdet/uPa
1+2	20 log R	1	0	...	...
1+2+3	20 log R	1	0	-170.36	-166.17

Appendix Table A3. Standard target calibration for 38 kHz single beam acoustic system. See Table A1 for instrument specifications, cables and settings. A three point suspension system was attached to the towed body.

A. GENERAL

Towed Body Model: Fathom Oceanology

Standard Target: Bal Tec Inc. Los Angeles Date : 9 January 1989
Material : Tungsten Carbide, grade 25, with 6% cobalt
f kHz : 38 c m/s : 1490
Diameter inch : 1.5 TS dB : -42.4

E. TRANSMIT LEVEL + RECEIVE SENSITIVITY - SPHERE CALIBRATION

Date: 1989 March 14, 11:00

Bandwidth kHz : 5.0 Alpha dB/m : 0.0099
TVG : 20 log R Cal : Off
Rec gain dB : 12 Chan 1 only
Trig interval s : 0.5 Blanking range m: Off
Xmit level dB : 0 Pulse width ms : 0.6
Rec TVG range ms: 7.7 Cable # : 1+2+3

#	Bot ms	Depth m	Det output V	+-	TL+RS dB	+-	Comment
1	85.0	1.0	6.50	0.1	85.83	0.13	Slack tide
2	85.0	1.0	6.84	0.2	86.27	0.26	Current 0.3 knots
							CALSPH1.DAT
3	65.0	15.9	7.20	0.4	86.72	0.51	
4	44.0	31.5	7.00	0.1	86.47	0.13	
5	22.5	46.5	7.00	.05	86.47	0.06	Very stable signal
6	85.0	1.0	6.50	0.1	85.83	0.13	
7	85.0	1.0	6.20	0.2	85.42	0.26	Use towed body shell

Appendix Table A4. Standard target calibration for 120 kHz dual beam acoustic system. See Table A2 for instrument specifications, cables and settings. A three point suspension system was attached to the towed body.

A. GENERAL

Towed Body Model: Fathom Oceanology

Standard Target: Bal Tec Inc. Los Angeles Date : 9 January 1989
Material : Tungsten Carbide, grade 25, with 6% cobalt
f kHz : 120 c m/s : 1490
Diameter inch : 1.5 TS dB : -39.49

E. TRANSMITLEVEL + RECEIVE SENSITIVITY - SPHERE CALIBRATION

Date: 1989 March 14, 14:00

Bandwidth kHz	: 5.0	Alpha dB/m	: 0.0369
TVG	: 20 log R	Cal	: Off
Rec gain dB	: See below	Chan 1 and 2	
Trig interval s	: 0.5	Blanking range m	: Off
Xmit level W	: See below	Pulse width ms	: 0.6
Rec TVG range ms	: 8.25	Cable #	: 1+2+3

#	Bot ms	Depth m	Xmit W	Reciver Gain dB	Det outp V Chan1	Det outp V Chan2	TL+RS dB Chan1	TL+RS dB Chan2	Comment
10	85.0	1.0	50	3x6	1.20	2.60	38.85	45.56	Note Xmit pow.
11	85.0	1.0	100	3x6	1.60	3.60	41.34	48.39	
12	85.0	1.0	200	3x6	2.20	5.20	44.11	51.58	
13	85.0	1.0	500	3x6	3.40	7.80	47.89	55.10	
14	85.0	1.0	1000	3x6	4.20	8.80	49.73	56.15	
15	85.0	1.0	1000	2x6	2.20	5.10	50.11	57.41	Lower transd.
16	26.0	46.5	1000	2x6	2.20	4.55	50.11	56.42	
17	47.2	31.5	1000	2x6	2.20	4.50	50.11	56.33	
18	68.4	15.9	1000	2x6	2.15	4.70	49.91	56.70	
19	87.5	1.0	1000	2x6	2.10	4.70	49.71	56.70	
20	87.5	1.0	1000	2x6	2.25	4.90	50.31	57.07	10 min later

APPENDIX B

Appendix Table B1. Vessel specifications.

Name: VELMA C	Length: 16.5 m	Beam: 4.2 m
Engine type: Diesel	Speed (maximum): 7.5 kn	
Navigational devices: Furuno LC 80 Loran		
Depth sounder: Furuno 551 colorscope depth sounder		
Skipper: Frank Ross		
No. of crew: 1		
Year built: 1928		

Appendix Table B2. A summary of the location, depth and bottom types of the 19 sunken gillnet sets made from March 14-23, 1989 off Brooks Peninsula.

Set #	Latitude	Longitude	Depth (m)	Bottom type
1	50°15.41'	128°05.46'	117	Smooth
2	50°15.72'	128°05.10'	115	Smooth
3	50°15.42'	128°05.00'	97	Rough pinnacle
4	50°15.44'	128°05.06'	104	Rough pinnacle
5	50°15.85'	128°07.21'	163	Smooth
6	50°16.13'	128°07.10'	152	Smooth
7	50°15.96'	128°07.67'	170	Smooth, above dropoff
8	50°16.20'	128°08.30'	170	Smooth, above dropoff
9	50°15.85'	128°07.79'	183-198	Shelf dropoff
10	50°16.06'	128°07.84'	170	Smooth, above dropoff
11	50°16.34'	128°06.06'	129	Rough pinnacle
12	50°15.58'	128°05.65'	123	Rough pinnacle
13	50°15.86'	128°04.98'	115	Rough pinnacle
14	50°16.56'	128°09.13'	174-201	Shelf dropoff
15	50°16.60'	128°09.18'	177-183	Smooth, above dropoff
16	50°15.54'	128°04.53'	101	Rough pinnacle
17	50°15.52'	128°04.53'	99	Rough pinnacle
18	50°15.89'	128°07.75'	177-196	Shelf dropoff
19	50°16.10'	128°08.23'	179-192	Shelf dropoff

Appendix Table B3. List of common names, species codes, and scientific names of species caught during the survey.

Common name	Species code	Scientific name
Red-banded rockfish	BAB	*Sebastes babcocki*
Silvergray rockfish	SG	*S. brevispinus*
Greenstriped rockfish	GS	*S. elongatus*
Widow rockfish	WID	*S. entomelas*
Yellowtail rockfish	YT	*S. flavidus*
Rosethorn rockfish	ROSE	*S. helvomaculatus*
Quillback rockfish	QB	*S. maliger*
Bocaccio	BOC	*S. paucispinus*
Canary rockfish	CAN	*S. pinniger*
Redstripe rockfish	RS	*S. proriger*
Yelloweye rockfish	YE	*S. ruberrimus*
Sharpchin rockfish	SC	*S. zacentrus*
Thornyhead	SEB	*Sebastolobus alascanus*
Lingcod	LC	*Ophiodon elongatus*

Appendix Table B4. A summary of the time of day, total hours soaked (D=Daytime, N=overnight), and net sizes for the 19 sunken gillnet sets made from March 15-23, 1989 off Brooks Peninsula.

Set no.	Date (March 1989)	Time	Total hours	Mesh size (cm)	Net length (m)
1	15-16	1600-0900	17:00 (N)	15.3	91
2	15	1615	never retrieved	7.6	91
3	15-16	1730-1230	19:00 (N)	15.3	91
4	15-16	1750-1600	22:00 (N)	7.6	91
5	17	0855-1415	5:20 (D)	7.6	91
6	17	0930-1300	3:25 (D)	15.3	91
7	17	1045-1510	4:25 (D)	15.3	91
8	17	1120-1700	5:40 (D)	7.6	91
9	18-19	1535-0830	16:55 (N)	7.6	45.5
10	18-19	1620-0945	17:25 (N)	7.6	91
11	18-19	1710-1130	18:20 (N)	7.6	45.5
12	19	0755-1245	4:50 (D)	7.6	91
13	19-22	1400-0900	67:00 (N)	7.6	91
14	19-20	1500-1000	19:00 (N)	7.6	91
15	19-20	1525-0900	17:35 (N)	7.6	45.5
16	22	1140-1530	3:50 (D)	7.6	91
17	22	1230-1630	4:00 (D)	7.6	45.5
18	22-23	1805-0805	14:00 (N)	7.6	45.5
19	22-23	1830-0915	14:45 (N)	7.6	91
			N mean= 17.6 hrs		
			D mean= 4.5 hrs		

Appendix Table B5a. Codes used to describe rockfish maturity stages, from Nagtegaal and Farlinger (1980), based on maturity stages described by Westrheim (1975).

Maturity	Code	Gonad condition
	0	Unknown
	1	Immature
Females	2	Maturing (small, yellow eggs; translucent or opaque
	3	Mature (large, orange-yellow eggs; opaque)
	4	Fertilized (large, orange yellow eggs; translucent)
	5	Embryos or larvae (including eyed eggs)
	6	Spent (large, flaccid, red ovaries, a few larvae may be present)
	7	Resting (moderate size, firm, red-gray ovaries)
	8	Resorbing
Males	2	Maturing (stringlike, translucent, white)
	3	Developing (swelling, brown-white)
	4	Developed (large, white; easily broken)
	5	Running (running sperm)
	6	Spent (flaccid, red)
	7	Resting (ribbon-like; small, brown)

Appendix Table B5b. Codes used to describe lingcod maturity stages, modified from Cass et al. (1984).

LINGCOD MATURITY CODES

Codes	Description- Gonad condition
0	unknown
1	immature; (males stringlike; females small)
2	immature; (males flat, transparent and slightly enlarged; females slightly enlarged)
females:	
3	ova are semi-transparent and less than 1 mm in diameter, ovaries fill one-third of the body cavity
4	ova are opaque and about 1 mm in diameter, ovaries fill two-thirds of the body cavity
5	ova are less than 2 mm in diameter, ovaries fill 80% of body cavity
6	ova are about 2 mm in diameter
7	ripe - ova are larger than 2 mm in diameter, ovaries visible fill and distend body cavity
8	spent - ovary may be bloodshot and purple in colour, ovary is flaccid and about one-third to two-thirds of the body cavity
9	resorbing - old ova are large to opaque and degenerative
10	recovering - ovaries returning to pre-ripening (code 3), are firm and fill less than half the body cavity, new ova are small
11	resting - ovaries firm and fill less than one-third of the body cavity
males:	
3	testes enlarged, filling less than one-quarter of the body cavity and white to brown in colour
4	testes enlarged to two-thirds of the body cavity, cross-sections of the gonad will produce milt
7	ripe - testes are large and full of milt
8	spent - testes are flaccid, reduced in size and may contain some milt
11	resting - testes are less than one-third of the body cavity, usually brown in colour and devoid of milt

Appendix Table B6. Date, set number, depth, species, sex, length, weight, maturity and fish number. Data are sorted by set and species. A fish number indicates that otoliths or fin rays were collected.

Date	Set no.	Depth (m)	Species	Sex[a]	Length (mm)	Weight (gm)	Maturity	Fish No.
Bottom type= Smooth >100 m								
890316	1	117	YT	1	344	601	1	43915
890316	1	117	YT	1	360	700	7	43913
890316	1	117	YT	1	395	855	1	43914
890316	1	117	YT	1	398	829	7	43906
890316	1	117	YT	1	403	886	7	43912
890316	1	117	YT	1	467	1503	7	43908
890316	1	117	YT	1	475	1556	7	43907
890316	1	117	YT	1	500	1723	1	43905
890316	1	117	YT	2	371	714	1	43911
890316	1	117	YT	2	414	991	1	43910
890316	1	117	YT	2	441	1274	1	43909
890316	1	117	LC	2	835			
890316	1	117	LC	2	845			
890317	5	163	BOC	1	634		7	
890317	5	163	BOC	1	634		7	
890317	5	163	BOC	1	652		7	
890317	5	163	BOC	1	669		7	
890317	5	163	BOC	1	685		7	
890317	5	163	BOC	1	709		7	
890317	5	163	BOC	1	736		7	
890317	5	163	BOC	2	644		7	
890317	5	163	BOC	2	660		7	
890317	5	163	BOC	2	705		7	
890317	5	163	BOC	2	737		7	
890317	5	163	LC	2	637		1	
890317	5	163	LC	2	685		2	
890317	5	163	LC	2	696		2	
890317	5	163	LC	2	710		2	
890317	5	163	LC	2	753		2	99
890317	5	163	LC	2	772		2	
890317	5	163	LC	2	821		10	
890317	5	163	LC	2	875		10	100
890317	5	163	LC	2	889		10	98
890317	5	163	LC	2	959		10	
890317	5	163	LC	2	960		10	
890317	5	163	LC	2	981		10	
890317	5	163	LC	2	991		10	
890317	6	152	BOC	1	628		7	
890317	6	152	BOC	1	655		7	
890317	6	152	BOC	2	624		3	
890317	6	152	BOC	2	662		7	
890317	6	152	CAN	2	570	2596	7	43108
890317	6	152	LC	2	572		1	93
890317	6	152	LC	2	745		2	82
890317	6	152	LC	2	755		2	70
890317	6	152	LC	2	786		2	73
890317	6	152	LC	2	800		2	84
890317	6	152	LC	2	803		2	77
890317	6	152	LC	2	808		2	80
890317	6	152	LC	2	809		2	89
890317	6	152	LC	2	810		10	95
890317	6	152	LC	2	810		2	91
890317	6	152	LC	2	815		10	69

Appendix Table B6 (cont'd)

Date	Set No.	Depth (m)	Species	Sex[a]	Length (mm)	Weight (gm)	Maturity	Fish No.
890317	6	152	LC	2	820		2	85
890317	6	152	LC	2	825		2	81
890317	6	152	LC	2	848		10	92
890317	6	152	LC	2	850		10	87
890317	6	152	LC	2	890		10	83
890317	6	152	LC	2	895		10	79
890317	6	152	LC	2	895		10	97
890317	6	152	LC	2	915		10	86
890317	6	152	LC	2	925		10	75
890317	6	152	LC	2	935		10	76
890317	6	152	LC	2	938		10	94
890317	6	152	LC	2	955		10	88
890317	6	152	LC	2	975		10	78
890317	6	152	LC	2	985		10	96
890317	6	152	LC	2	985		10	74
890317	6	152	LC	2	1000		10	90
890317	6	152	LC	2	1035		10	72
890317	6	152	LC	2	1078		10	71
Bottom type= Rough pinnacle 95-130 m								
890316	3	97	SG	1	618	3188	7	43225
890316	3	97	YT	1	480	1615	7	43901
890316	3	97	YT	1	483	1755	7	43903
890316	3	97	YT	1	534	2333	7	43902
890316	3	97	YT	2	454	1308	1	43904
890316	3	97	BOC	1	525		6	
890316	3	97	BOC	1	595		6	
890316	3	97	BOC	1	606		6	
890316	3	97	BOC	2	608		5	
890316	3	97	BOC	1	610		6	
890316	3	97	BOC	1	616		6	
890316	3	97	BOC	1	622		6	
890316	3	97	BOC	2	630		5	
890316	3	97	BOC	1	638		6	
890316	3	97	BOC	1	645		6	
890316	3	97	BOC	2	648		6	
890316	3	97	BOC	1	665		6	
890316	3	97	BOC	1	670		6	
890316	3	97	BOC	2	670		5	
890316	3	97	BOC	1	674		6	
890316	3	97	BOC	2	686		6	
890316	3	97	BOC	1	687		6	
890316	3	97	BOC	1	687		6	
890316	3	97	BOC	1	688		6	
890316	3	97	BOC	1	690		6	
890316	3	97	BOC	1	691		6	
890316	3	97	BOC	2	695		6	
890316	3	97	BOC	1	703		6	
890316	3	97	BOC	2	735		5	
890316	3	97	BOC	2	786		6	
890316	3	97	CAN	1	441	1465	1	43147
890316	3	97	CAN	1	451	1792	1	43148
890316	3	97	CAN	2	484	1976	7	43155
890316	3	97	CAN	2	486	2131	1	43150
890316	3	97	CAN	1	495	1958	7	43156

Appendix Table B6 (cont'd)

Date	Set No.	Depth (m)	Species	Sex[a]	Length (mm)	Weight (gm)	Maturity	Fish No.
890316	3	97	CAN	1	496	2148	3	43149
890316	3	97	CAN	2	506	2220	1	43152
890316	3	97	CAN	2	511	2438	1	43145
890316	3	97	CAN	2	520	2274	7	43146
890316	3	97	CAN	2	524	3078	1	43154
890316	3	97	CAN	1	543	2810	3	43151
890316	3	97	CAN	1	560	3202	4	43153
890316	3	97	CAN	1	572	3196	7	43157
890316	3	97	YE	2	521	3100	3	43005
890316	3	97	LC	2	792		8	39
890316	3	97	LC	2	793		8	31
890316	3	97	LC	2	795		8	1
890316	3	97	LC	2	798		2	33
890316	3	97	LC	2	799		8	23
890316	3	97	LC	2	808		8	13
890316	3	97	LC	2	811		8	29
890316	3	97	LC	2	813		8	35
890316	3	97	LC	2	814		8	50
890316	3	97	LC	2	823		8	44
890316	3	97	LC	2	824		8	36
890316	3	97	LC	2	826		8	45
890316	3	97	LC	2	831		8	34
890316	3	97	LC	2	832		8	37
890316	3	97	LC	2	847		8	15
890316	3	97	LC	2	848		8	30
890316	3	97	LC	2	850		8	24
890316	3	97	LC	2	858		8	41
890316	3	97	LC	2	874		8	49
890316	3	97	LC	2	876		8	43
890316	3	97	LC	2	892		8	38
890316	3	97	LC	2	895		8	46
890316	3	97	LC	2	896		8	21
890316	3	97	LC	2	896		8	10
890316	3	97	LC	2	915		8	47
890316	3	97	LC	2	920		8	9
890316	3	97	LC	2	920		8	22
890316	3	97	LC	2	921		8	19
890316	3	97	LC	2	923		8	40
890316	3	97	LC	2	924		8	14
890316	3	97	LC	2	925		8	5
890316	3	97	LC	2	938		8	42
890316	3	97	LC	2	946		8	28
890316	3	97	LC	2	955		8	11
890316	3	97	LC	2	955		8	16
890316	3	97	LC	2	958		8	3
890316	3	97	LC	2	966		8	27
890316	3	97	LC	2	971		8	20
890316	3	97	LC	2	983		8	2
890316	3	97	LC	2	986		8	8
890316	3	97	LC	2	995		8	4
890316	3	97	LC	2	1026		8	48
890316	3	97	LC	2	1071		8	26
890316	3	97	LC	2	1080		8	7
890316	3	97	LC	2	1091		8	32
890316	3	97	LC	2	1096		8	12
890316	3	97	LC	2	1104		8	17
890316	3	97	LC	2	1178		8	25

Appendix Table B6 (cont'd)

Date	Set No.	Depth (m)	Species	Sex[a]	Length (mm)	Weight (gm)	Maturity	Fish No.
890316	3	97	LC	2	1184		8	18
890316	3	97	LC	2	1210		8	6
890316	4	104	YT	1	267	276	1	43932
890316	4	104	YT	1	284	349	1	43931
890316	4	104	YT	1	291	375	7	43934
890316	4	104	YT	1	294	329	1	43942
890316	4	104	YT	1	295	353	1	43944
890316	4	104	YT	1	296	359	1	43929
890316	4	104	YT	1	305	385	7	43930
890316	4	104	YT	1	305	378	1	43935
890316	4	104	YT	1	306	382	1	43953
890316	4	104	YT	1	308	319	1	43966
890316	4	104	YT	1	310	449	1	43918
890316	4	104	YT	1	313	420	1	43945
890316	4	104	YT	1	315	420	1	43959
890316	4	104	YT	1	318	433	1	43963
890316	4	104	YT	1	318	440	7	43920
890316	4	104	YT	1	320	525	1	43955
890316	4	104	YT	1	320	491	1	43950
890316	4	104	YT	1	322	412	1	43922
890316	4	104	YT	1	323	471	1	43940
890316	4	104	YT	1	324	469	1	43939
890316	4	104	YT	1	340	581	1	43954
890316	4	104	YT	1	348	626	1	43937
890316	4	104	YT	1	349	572	7	43916
890316	4	104	YT	1	352	663	7	43925
890316	4	104	YT	1	354	659	7	43938
890316	4	104	YT	1	364	699	7	43961
890316	4	104	YT	1	366	673	1	43964
890316	4	104	YT	1	374	338	1	43936
890316	4	104	YT	1	376	835	7	43951
890316	4	104	YT	1	382	781	7	43921
890316	4	104	YT	1	382	915	1	43965
890316	4	104	YT	1	391	836	7	43923
890316	4	104	YT	1	392	350	1	43967
890316	4	104	YT	1	398	1047	7	43927
890316	4	104	YT	1	398	1109	7	43928
890316	4	104	YT	1	406	1027	7	43947
890316	4	104	YT	1	411	1059	7	43946
890316	4	104	YT	1	411	1082	7	43924
890316	4	104	YT	1	412	1078	7	43917
890316	4	104	YT	1	447	1375	1	43933
890316	4	104	YT	2	296	386	1	43943
890316	4	104	YT	2	300	369	1	43952
890316	4	104	YT	2	322	412	1	43962
890316	4	104	YT	2	325	522	1	43941
890316	4	104	YT	2	331	485	1	43926
890316	4	104	YT	2	331	503	1	43949
890316	4	104	YT	2	342	563	1	43956
890316	4	104	YT	2	347	707	1	43969
890316	4	104	YT	2	355	703	1	43957
890316	4	104	YT	2	390	924	1	43919
890316	4	104	YT	2	405	881	1	43958
890316	4	104	YT	2	414	1056	1	43948
890316	4	104	YT	2	444	1254	1	43960
890316	4	104	YT	2	468	731	1	43968
890316	4	104	ROSE	1	245		7	

Appendix Table B6 (cont'd)

Date	Set No.	Depth (m)	Species	Sex[a]	Length (mm)	Weight (gm)	Maturity	Fish No.
890316	4	104	ROSE	1	273		7	
890316	4	104	ROSE	2	227		3	
890316	4	104	ROSE	2	231		1	
890316	4	104	ROSE	2	233		3	
890316	4	104	ROSE	2	247		3	
890316	4	104	ROSE	2	262		3	
890316	4	104	ROSE	2	274		3	
890316	4	104	ROSE	2	299		3	
890316	4	104	BOC	1	603		7	
890316	4	104	BOC	1	671		6	
890316	4	104	BOC	1	690		6	
890316	4	104	BOC	1	701		6	
890316	4	104	BOC	2	620		7	
890316	4	104	BOC	2	672		6	
890316	4	104	BOC	2	710		7	
890316	4	104	BOC	2	738		7	
890316	4	104	BOC	2	752		6	
890316	4	104	CAN	1	362	733	1	43160
890316	4	104	CAN	1	390	1058	1	43164
890316	4	104	CAN	1	404	1138	1	43161
890316	4	104	CAN	1	428	1501	1	43159
890316	4	104	CAN	2	405	1120	1	43162
890316	4	104	CAN	2	432	1266	1	43163
890316	4	104	CAN	2	445	1580	1	43158
890316	4	104	YE	2	287	360	1	43001
890316	4	104	SC	0	154	49	0	
890316	4	104	LC	1	689		11	
890316	4	104	LC	2	571		1	
890316	4	104	LC	2	755		2	
890316	4	104	LC	2	758		10	
890316	4	104	LC	2	784		2	
890316	4	104	LC	2	837		2	
890316	4	104	LC	2	927		10	
890316	4	104	LC	2	938		10	
890316	4	104	LC	2	970		10	
890316	4	104	LC	2	975		10	
890316	4	104	LC	2	980		10	
890316	4	104	LC	2	996		11	
890316	4	104	LC	2	1125		10	
890319	11	129	SG	2	555	2332	7	43246
890319	11	129	WID	2	396	953	1	16851
890319	11	129	YT	1	340	575	1	16634
890319	11	129	YT	1	484	1846	7	16632
890319	11	129	YT	2	346	590	1	16630
890319	11	129	YT	2	371	749	1	16633
890319	11	129	YT	2	508	1761	7	16631
890319	11	129	BOC	1	670	3554	7	43809
890319	11	129	CAN	0	432			43181
890319	11	129	YE	2	668	5584	3	43007
890319	11	129	LC	2	675	2500	0	
890319	11	129	LC	2	878	6000	0	
890319	11	129	LC	2	955	8000	0	
890319	11	129	LC	2	985	9500	0	
890319	11	129	LC	2	1045	12000	0	
890319	11	129	LC	2	1070	13000	0	
890319	12	123	YT	1	309	932	7	16603
890319	12	123	YT	1	340	594	7	16626

Appendix Table B6 (cont'd)

Date	Set No.	Depth (m)	Species	Sex[a]	Length (mm)	Weight (gm)	Maturity	Fish No.
890319	12	123	YT	1	359	639	1	43999
890319	12	123	YT	1	368	840	7	16607
890319	12	123	YT	1	384	873	7	43982
890319	12	123	YT	1	385	873	7	16604
890319	12	123	YT	1	386	814	7	43996
890319	12	123	YT	1	387	948	7	43998
890319	12	123	YT	1	391	1033	7	16606
890319	12	123	YT	1	394	1001	1	43974
890319	12	123	YT	1	394	934	7	43976
890319	12	123	YT	1	399	973	7	16601
890319	12	123	YT	1	406	1000	7	43977
890319	12	123	YT	1	410	929	7	16629
890319	12	123	YT	1	412	1010	7	43994
890319	12	123	YT	1	414	1134	7	16602
890319	12	123	YT	1	421	1083	7	43975
890319	12	123	YT	1	429	1164	7	43979
890319	12	123	YT	1	430	1140	7	43978
890319	12	123	YT	1	435	1207	1	16615
890319	12	123	YT	1	436	1380	7	16619
890319	12	123	YT	1	436	1238	3	43973
890319	12	123	YT	1	440	1330	7	43995
890319	12	123	YT	1	443	1424	7	16621
890319	12	123	YT	1	445	1320	7	43989
890319	12	123	YT	1	446	1245	7	43971
890319	12	123	YT	1	459	1623	7	16622
890319	12	123	YT	1	478	1848	1	44000
890319	12	123	YT	1	501	1934	7	43972
890319	12	123	YT	2	322	462	1	43981
890319	12	123	YT	2	360	727	1	43991
890319	12	123	YT	2	362	721	1	16625
890319	12	123	YT	2	362	700	1	43997
890319	12	123	YT	2	365	713	1	43990
890319	12	123	YT	2	383	857	1	16608
890319	12	123	YT	2	385	961	1	16616
890319	12	123	YT	2	385	834	1	16605
890319	12	123	YT	2	385	882	1	43983
890319	12	123	YT	2	386	848	1	43986
890319	12	123	YT	2	392	830	1	16612
890319	12	123	YT	2	400	1013	1	16628
890319	12	123	YT	2	404	1005	1	16623
890319	12	123	YT	2	406	1107	1	16620
890319	12	123	YT	2	409	1054	1	43984
890319	12	123	YT	2	411	1007	1	43987
890319	12	123	YT	2	418	1125	1	43988
890319	12	123	YT	2	419	1049	1	16617
890319	12	123	YT	2	419	1100	7	43980
890319	12	123	YT	2	422	1068	1	16614
890319	12	123	YT	2	422	1104	1	16613
890319	12	123	YT	2	425	1094	1	16611
890319	12	123	YT	2	429	1220	1	16610
890319	12	123	YT	2	439	1306	1	43985
890319	12	123	YT	2	452	1578	1	16624
890319	12	123	YT	2	457	1390	1	16609
890319	12	123	YT	2	460	1562	1	16627
890319	12	123	YT	2	460	1419	1	16618
890319	12	123	YT	2	482	850	1	43992
890319	12	123	YT	2	482	1806	1	43993

Appendix Table B6 (cont'd)

Date	Set No.	Depth (m)	Species	Sex[a]	Length (mm)	Weight (gm)	Maturity	Fish No.
890319	12	123	YT	2	540	2165	7	43970
890319	12	123	ROSE	1	279	291	7	
890319	12	123	ROSE	2	226	127	1	
890319	12	123	CAN	1	458	3236	3	43177
890319	12	123	CAN	1	544	2692	3	43178
890319	12	123	CAN	2	511	2195	7	43176
890319	12	123	YE	2	525	2915	4	43006
890319	12	123	LC	2	748	4500	0	
890319	12	123	LC	2	835	5000	0	
890319	12	123	LC	2	865	5500	0	
890319	12	123	LC	2	868	5500	0	
890319	12	123	LC	2	885	6000	0	
890319	12	123	LC	2	895	8000	0	
890319	12	123	LC	2	910	7500	0	
890319	12	123	LC	2	910	6500	0	
890319	12	123	LC	2	920	7000	0	
890319	12	123	LC	2	925	7500	0	
890319	12	123	LC	2	925	7500	0	
890319	12	123	LC	2	935	7000	0	
890319	12	123	LC	2	940	8000	0	
890319	12	123	LC	2	955	9000	0	
890319	12	123	LC	2	955	9000	0	
890319	12	123	LC	2	975	8500	0	
890319	12	123	LC	2	975	8000	0	
890319	12	123	LC	2	975	9000	0	
890319	12	123	LC	2	985	9000	0	
890319	12	123	LC	2	990	8500	0	
890319	12	123	LC	2	990	7500	0	
890319	12	123	LC	2	1020	9000	0	
890319	12	123	LC	2	1105	15000	0	
890319	12	123	LC	2	1165	16000	0	
890322	13	115	YT	1	341		2	45012
890322	13	115	YT	1	355		1	45019
890322	13	115	YT	1	367		7	45016
890322	13	115	YT	1	376		1	45015
890322	13	115	YT	1	380		1	45017
890322	13	115	YT	1	475		7	45013
890322	13	115	YT	1	498		7	45008
890322	13	115	YT	1	498		7	45007
890322	13	115	YT	1	505		7	45014
890322	13	115	YT	2			1	45018
890322	13	115	YT	2	352		1	45011
890322	13	115	YT	2	380		1	45020
890322	13	115	YT	2	389		1	45010
890322	13	115	YT	2	446		1	45009
890322	13	115	CAN	1	416		1	43372
890322	13	115	LC	1	561	2000	1	
890322	13	115	LC	1	645	2000	8	
890322	13	115	LC	2	562	2000	1	
890322	13	115	LC	2	780	4500	0	
890322	13	115	LC	2	819	6000	0	
890322	13	115	LC	2	825	6500	0	
890322	13	115	LC	2	825	6000	0	
890322	13	115	LC	2	878	6500	0	
890322	13	115	LC	2	890	7000	0	
890322	13	115	LC	2	925	8000	0	
890322	13	115	LC	2	940	8000	0	

Appendix Table B6 (cont'd)

Date	Set No.	Depth (m)	Species	Sex[a]	Length (mm)	Weight (gm)	Maturity	Fish No.
890322	13	115	LC	2	1105	14000	0	
890322	13	115	LC	2	1125	15500	0	
890322	16	101	CAN	2	380		1	43363
890322	16	101	CAN	2	435		1	43364
890322	16	101	CAN	2	476		1	43362
890322	17	99	CAN	1	261		1	43337
890322	17	99	CAN	1	286		1	43351
890322	17	99	CAN	1	295		1	43352
890322	17	99	CAN	1	324		1	43345
890322	17	99	CAN	1	326		1	43336
890322	17	99	CAN	1	330		1	43346
890322	17	99	CAN	1	331		1	43339
890322	17	99	CAN	1	335		1	43338
890322	17	99	CAN	1	336		1	43342
890322	17	99	CAN	1	387		1	43334
890322	17	99	CAN	1	393		1	43350
890322	17	99	CAN	1	395		1	43344
890322	17	99	CAN	1	418		1	43343
890322	17	99	CAN	1	450		3	43347
890322	17	99	CAN	2	266		1	43354
890322	17	99	CAN	2	274		1	43348
890322	17	99	CAN	2	278		1	43353
890322	17	99	CAN	2	289		1	43357
890322	17	99	CAN	2	296		1	43335
890322	17	99	CAN	2	307		1	43355
890322	17	99	CAN	2	330		1	43356
890322	17	99	CAN	2	333		1	43340
890322	17	99	CAN	2	387		1	43349
890322	17	99	CAN	2	459		1	43341
890322	17	99	LC	2	498	1500	1	
890322	17	99	LC	2	762	5000	0	
890322	17	99	LC	2	807	5500	0	
890322	17	99	LC	2	884	7000	0	
890322	17	99	LC	2	895	8000	0	
890322	17	99	LC	2	915	8000	0	
890322	17	99	LC	2	974	9500	0	
890322	17	99	LC	2	975	9000	0	
Bottom type= Smooth, above shelf dropoff >170 m								
890317	7	170	SG	2	601	3352	4	43243
890317	7	170	BOC	1	600	2425	7	43801
890317	7	170	BOC	2	616	2902	7	43802
890317	7	170	CAN	1	485	2059	4	43135
890317	7	170	CAN	1	486	1871	2	43119
890317	7	170	CAN	1	488	2140	4	43141
890317	7	170	CAN	1	491	1993	4	43121
890317	7	170	CAN	1	500	2179	4	43140
890317	7	170	CAN	1	500	2112	4	43124
890317	7	170	CAN	1	522	2194	4	43139
890317	7	170	CAN	1	526	2606	4	43134
890317	7	170	CAN	1	527	2386	3	43143
890317	7	170	CAN	1	528	2498	4	43128
890317	7	170	CAN	1	530	2542	3	43138
890317	7	170	CAN	1	531	2959	4	43136
890317	7	170	CAN	1	535	2805	4	43122

Appendix Table B6 (cont'd)

Date	Set No.	Depth (m)	Species	Sex[a]	Length (mm)	Weight (gm)	Maturity	Fish No.
890317	7	170	CAN	1	556	2693	4	43131
890317	7	170	CAN	1	565	2710	3	43120
890317	7	170	CAN	2	404	2020	2	43137
890317	7	170	CAN	2	488	2041	1	43125
890317	7	170	CAN	2	490	2061	1	43126
890317	7	170	CAN	2	491	2066	1	43127
890317	7	170	CAN	2	491	2299	1	43144
890317	7	170	CAN	2	515	2095	1	43132
890317	7	170	CAN	2	515	2370	1	43133
890317	7	170	CAN	2	516	2691	5	43129
890317	7	170	CAN	2	540	2702	7	43142
890317	7	170	CAN	2	540	2860	5	43130
890317	7	170	CAN	2	560	2799	6	43123
890317	8	170	BAB	2	542	3018	3	
890317	8	170	SG	1	459	1503	7	43233
890317	8	170	SG	1	495	1550	7	43229
890317	8	170	SG	1	515	1649	7	43228
890317	8	170	SG	1	516	1590	7	43238
890317	8	170	SG	1	528	1944	7	43239
890317	8	170	SG	1	555	2058	7	43226
890317	8	170	SG	1	555	1976	7	43242
890317	8	170	SG	1	570	2389	7	43240
890317	8	170	SG	1	590	2282	7	43236
890317	8	170	SG	1	606	3310	3	43237
890317	8	170	SG	1	608	2714	7	43230
890317	8	170	SG	2	530	2116	3	43241
890317	8	170	SG	2	564	2799	3	43234
890317	8	170	SG	2	576	3128	3	43235
890317	8	170	SG	2	581	2717	1	43231
890317	8	170	SG	2	588	2747	3	43227
890317	8	170	SG	2	621	3462	3	43232
890317	8	170	ROSE	2	236	175	1	
890317	8	170	ROSE	2	256	251	3	
890317	8	170	CAN	1	425	1371	1	43112
890317	8	170	CAN	1	479	2049	4	43111
890317	8	170	CAN	1	492	1659	3	43105
890317	8	170	CAN	1	514	2296	4	43110
890317	8	170	CAN	1	518	2140	3	43116
890317	8	170	CAN	1	522	2095	4	43108
890317	8	170	CAN	1	524	2380	3	43106
890317	8	170	CAN	1	525	2612	3	43115
890317	8	170	CAN	1	530	2537	3	43107
890317	8	170	CAN	1	530	2575	3	43109
890317	8	170	CAN	1	540	2400	3	43101
890317	8	170	CAN	1	547	2465	3	43104
890317	8	170	CAN	1	578	2941	3	43102
890317	8	170	CAN	2	452	1626	1	43103
890317	8	170	CAN	2	455	1674	1	43117
890317	8	170	CAN	2	459	1890	1	43114
890317	8	170	CAN	2	506	2310	1	43113
890317	8	170	BOC	1	563		7	
890317	8	170	BOC	1	590		7	
890317	8	170	BOC	1	608	2329	7	43807
890317	8	170	BOC	1	610		7	
890317	8	170	BOC	1	613		7	
890317	8	170	BOC	1	618		7	
890317	8	170	BOC	1	622		7	

Appendix Table B6 (cont'd)

Date	Set No.	Depth (m)	Species	Sex[a]	Length (mm)	Weight (gm)	Maturity	Fish No.
890317	8	170	BOC	1	622		7	
890317	8	170	BOC	1	628		7	
890317	8	170	BOC	1	628		7	
890317	8	170	BOC	1	634	3276	7	43804
890317	8	170	BOC	1	639	2862	7	43808
890317	8	170	BOC	1	646		7	
890317	8	170	BOC	1	650		7	
890317	8	170	BOC	1	650		7	
890317	8	170	BOC	1	654		7	
890317	8	170	BOC	1	655	2906	7	43803
890317	8	170	BOC	1	660		7	
890317	8	170	BOC	1	662		7	
890317	8	170	BOC	1	667	4424	4	43805
890317	8	170	BOC	1	670		7	
890317	8	170	BOC	1	670		7	
890317	8	170	BOC	1	675		7	
890317	8	170	BOC	1	682		7	
890317	8	170	BOC	1	682		7	
890317	8	170	BOC	1	689		7	
890317	8	170	BOC	1	694		7	
890317	8	170	BOC	1	700		7	
890317	8	170	BOC	1	703		7	
890317	8	170	BOC	1	706		7	
890317	8	170	BOC	1	708		7	
890317	8	170	BOC	1	712		7	
890317	8	170	BOC	1	716		7	
890317	8	170	BOC	1	718	4186	7	43806
890317	8	170	BOC	1	721		7	
890317	8	170	BOC	1	726		7	
890317	8	170	BOC	1	747		7	
890317	8	170	BOC	1	753		7	
890317	8	170	BOC	1	762		7	
890317	8	170	BOC	2	665		7	
890317	8	170	BOC	2	775		7	
890317	8	170	BOC	2	781		7	
890317	8	170	BOC	2	801		7	
890317	8	170	BOC	2	815		7	
890317	8	170	BOC	2	849		7	
890317	8	170	YE	1	625	4468	7	43002
890317	8	170	YE	2	581	4084	3	43004
890317	8	170	YE	2	652	5712	7	43003
890317	8	170	SC	1	232	193	7	43532
890317	8	170	SC	1	242	149	1	43530
890317	8	170	SC	1	242	187	7	43527
890317	8	170	SC	1	246	189	7	43537
890317	8	170	SC	1	249	225	7	43504
890317	8	170	SC	1	251	239	7	43529
890317	8	170	SC	1	253	225	7	43519
890317	8	170	SC	1	253	245	7	43507
890317	8	170	SC	1	254	254	7	43512
890317	8	170	SC	1	256	223	7	43528
890317	8	170	SC	1	258	223	7	43536
890317	8	170	SC	1	260	205	7	43513
890317	8	170	SC	1	265	256	1	43535
890317	8	170	SC	1	270	269	7	43516
890317	8	170	SC	1	271	302	7	43511
890317	8	170	SC	1	272	300	7	43521

Appendix Table B6 (cont'd)

Date	Set No.	Depth (m)	Species	Sex[a]	Length (mm)	Weight (gm)	Maturity	Fish No.
890317	8	170	SC	1	303	361	7	43526
890317	8	170	SC	2	246	238	4	43531
890317	8	170	SC	2	266	314	4	43517
890317	8	170	SC	2	281	347	3	43520
890317	8	170	SC	2	287	380	3	43533
890317	8	170	SC	2	289	344	3	43505
890317	8	170	SC	2	298	414	1	43510
890317	8	170	SC	2	298	362	3	43508
890317	8	170	SC	2	299	424	3	43515
890317	8	170	SC	2	302	454	3	43525
890317	8	170	SC	2	304	347	3	43523
890317	8	170	SC	2	310	388	3	43506
890317	8	170	SC	2	311	477	3	43524
890317	8	170	SC	2	313	511	3	43522
890317	8	170	SC	2	314	512	3	43518
890317	8	170	SC	2	318	493	3	43502
890317	8	170	SC	2	322	512	4	43534
890317	8	170	SC	2	322	541	3	43514
890317	8	170	SC	2	335	649	3	43503
890317	8	170	SC	2	337	620	3	43501
890317	8	170	SC	2	339	594	3	43509
890317	8	170	LC	2	676		2	64
890317	8	170	LC	2	768		2	60
890317	8	170	LC	2	820		10	66
890317	8	170	LC	2	835		2	56
890317	8	170	LC	2	849		2	63
890317	8	170	LC	2	865		10	52
890317	8	170	LC	2	870		10	68
890317	8	170	LC	2	887		10	57
890317	8	170	LC	2	891		2	61
890317	8	170	LC	2	917		10	58
890317	8	170	LC	2	928		10	62
890317	8	170	LC	2	932		10	55
890317	8	170	LC	2	935		10	54
890317	8	170	LC	2	955		10	65
890317	8	170	LC	2	965		10	59
890317	8	170	LC	2	975		10	51
890317	8	170	LC	2	1030		10	67
890317	8	170	LC	2	1045		10	53
890319	10	170	SG	1	555		7	43205
890319	10	170	SG	1	556		7	43202
890319	10	170	SG	1	595		7	43203
890319	10	170	SG	2	502		2	43207
890319	10	170	SG	2	577		2	43204
890319	10	170	SG	2	582		1	43208
890319	10	170	SG	2	585		3	43201
890319	10	170	SG	2	602		3	43206
890319	10	170	WID	1	352		1	45211
890319	10	170	WID	1	387		1	45203
890319	10	170	WID	1	416		7	45220
890319	10	170	WID	1	426		7	45224
890319	10	170	WID	1	428		7	45210
890319	10	170	WID	1	438		7	45201
890319	10	170	WID	1	442		7	45214
890319	10	170	WID	1	445		7	45218
890319	10	170	WID	1	446		7	45208
890319	10	170	WID	1	448		7	45209

Appendix Table B6 (cont'd)

Date	Set No.	Depth (m)	Species	Sex[a]	Length (mm)	Weight (gm)	Maturity	Fish No.
890319	10	170	WID	1	454		7	45212
890319	10	170	WID	1	457		7	45207
890319	10	170	WID	1	461		7	45223
890319	10	170	WID	1	461		7	45221
890319	10	170	WID	1	464		7	45217
890319	10	170	WID	1	482		7	45204
890319	10	170	WID	2	437		4	45225
890319	10	170	WID	2	444		1	45213
890319	10	170	WID	2	462		7	45202
890319	10	170	WID	2	479		5	45216
890319	10	170	WID	2	485		7	45206
890319	10	170	WID	2	533		4	45205
890319	10	170	WID	2	540		4	45222
890319	10	170	WID	2	541		5	45219
890319	10	170	WID	2	642		4	45215
890319	10	170	YT	1	459		7	45002
890319	10	170	YT	2	468		4	45001
890319	10	170	YT	2	525		1	45003
890319	10	170	CAN	1	427		1	43319
890319	10	170	CAN	1	430		1	43321
890319	10	170	CAN	1	461		7	43327
890319	10	170	CAN	1	476		7	43318
890319	10	170	CAN	1	484		7	43326
890319	10	170	CAN	1	495		7	43322
890319	10	170	CAN	1	496		7	43306
890319	10	170	CAN	1	501		7	43320
890319	10	170	CAN	1	504		7	43325
890319	10	170	CAN	1	512		7	43314
890319	10	170	CAN	1	513		7	43309
890319	10	170	CAN	1	517		7	43303
890319	10	170	CAN	1	519		7	43308
890319	10	170	CAN	1	523		7	43307
890319	10	170	CAN	1	527		7	43305
890319	10	170	CAN	1	532		7	43316
890319	10	170	CAN	1	536		7	43329
890319	10	170	CAN	1	555		7	43304
890319	10	170	CAN	1	555		7	43310
890319	10	170	CAN	1	631		7	43302
890319	10	170	CAN	2	438		1	43323
890319	10	170	CAN	2	448		1	43317
890319	10	170	CAN	2	482		1	43301
890319	10	170	CAN	2	493		1	43315
890319	10	170	CAN	2	531		4	43312
890319	10	170	CAN	2	539		1	43311
890319	10	170	CAN	2	570		7	43330
890319	10	170	CAN	2	590		7	43324
890319	10	170	CAN	2	602		4	43328
890319	10	170	CAN	2	615		2	43313
890319	10	170	BAB	2	329		2	45301
890319	10	170	LC	1	621	2500	0	
890319	10	170	LC	2	840	7000	0	
890319	10	170	LC	2	968	9000	0	
890319	10	170	LC	2	976	11000	0	
890319	10	170	LC	2	995	10000	0	
890319	10	170	LC	2	1008	8500	0	
890320	15	180	SG	1	525	1790	7	43244
890320	15	180	SG	1	559	2473	7	43245

Appendix Table B6 (cont'd)

Date	Set No.	Depth (m)	Species	Sex[a]	Length (mm)	Weight (gm)	Maturity	Fish No.
890320	15	180	ROSE	2	235	229	3	
890320	15	180	ROSE	2	276	387	3	
890320	15	180	CAN	1	426	1381	1	43173
890320	15	180	CAN	1	440	1714	4	43174
890320	15	180	CAN	1	459	1709	4	43166
890320	15	180	CAN	1	506	2192	4	43171
890320	15	180	CAN	1	519	2349	7	43168
890320	15	180	CAN	2	470	1801	1	43175
890320	15	180	CAN	2	530	2864	4	43169
890320	15	180	CAN	2	536	2592	7	43167
890320	15	180	CAN	2	542	2857	3	43170
890320	15	180	CAN	2	564	3228	1	43172
890320	15	180	CAN	2	605	3046	7	43165
890320	15	180	LC	2	945	8500	0	
890320	15	180	LC	2	990	8500	0	
Bottom type= Shelf dropoff >170 m								
890319	9	191	BAB	1	478	1870	7	
890319	9	191	BAB	2	464	1373	1	
890319	9	191	BAB	2	511	2351	4	
890319	9	191	SG	1	526	1911	7	43247
890319	9	191	WID	1	442	1166	7	16849
890319	9	191	WID	1	443	1233	7	16841
890319	9	191	WID	1	447	1239	7	16847
890319	9	191	WID	1	450	1288	7	16846
890319	9	191	WID	1	451	1240	7	16843
890319	9	191	WID	1	454	1092	7	16848
890319	9	191	WID	1	456	1373	7	16850
890319	9	191	WID	1	461	1285	7	16842
890319	9	191	WID	2	520	2012	7	16845
890319	9	191	WID	2	530	2409	5	16844
890319	9	191	BOC	1	502	1356	7	43810
890319	9	191	CAN	1	461	1633	7	43179
890319	9	191	CAN	2	549	2001	7	43180
890319	9	191	BAB	1	306	379	7	
890319	9	191	BAB	1	320	408	7	
890319	9	191	SC	1			1	43555
890319	9	191	SC	1	235	206	1	43553
890319	9	191	SC	1	236	160	7	43551
890319	9	191	SC	1	249	188	1	43550
890319	9	191	SC	1	252	202	7	43542
890319	9	191	SC	1	253	214	7	43543
890319	9	191	SC	1	255	238	7	43539
890319	9	191	SC	1	255	215	7	43554
890319	9	191	SC	1	256	261	7	43541
890319	9	191	SC	1	256	254	7	43549
890319	9	191	SC	1	262	219	7	43552
890319	9	191	SC	1	262	234	7	43546
890319	9	191	SC	1	272	237	1	43547
890319	9	191	SC	2	274	303	1	43544
890319	9	191	SC	2	274	283	1	43540
890319	9	191	SC	2	284	316	1	43548
890319	9	191	SC	2	310	457	1	43545
890319	9	191	SC	2	325	486	3	43538
890319	9	191	SEB	2	264	239	3	

Appendix Table B6 (cont'd)

Date	Set No.	Depth (m)	Species	Sex[a]	Length (mm)	Weight (gm)	Maturity	Fish No.
890319	9	191	SEB	2	285	246	1	
890319	9	191	LC	2	809	5000	0	
890319	9	191	LC	2	840	5000	0	
890319	9	191	LC	2	858	6000	0	
890319	9	191	LC	2	940	6000	0	
890319	9	191	LC	2	987	9000	0	
890319	9	191	LC	2	1038	9200	0	
890320	14	188	SG	1	532		7	43215
890320	14	188	SG	1	550		7	43218
890320	14	188	SG	1	560		7	43220
890320	14	188	SG	1	567		7	43217
890320	14	188	SG	1	581		7	43210
890320	14	188	SG	1	588		7	43211
890320	14	188	SG	2	556		1	43209
890320	14	188	SG	2	557		3	43214
890320	14	188	SG	2	583		3	43213
890320	14	188	SG	2	586		3	43219
890320	14	188	SG	2	591		3	43212
890320	14	188	SG	2	605		3	43216
890320	14	188	CAN	1	511		7	43331
890320	14	188	CAN	2	495		1	43333
890320	14	188	CAN	2	529		2	43332
890320	14	188	LC	2	810	4500	0	
890320	14	188	LC	2	830	5500	0	
890320	14	188	LC	2	840	6000	0	
890320	14	188	LC	2	1000	13000	0	
890320	14	188	LC	2	1005	9500	0	
890320	14	188	LC	2	1045	11000	0	
890323	18	187	SG	1	516		7	43223
890323	18	187	SG	2	472		2	43221
890323	18	187	SG	2	515		3	43222
890323	18	187	WID	0	336		0	45241
890323	18	187	WID	1	345		1	45234
890323	18	187	WID	1	370		1	45236
890323	18	187	WID	1	395		2	45240
890323	18	187	WID	1	402		1	45238
890323	18	187	WID	1	406		2	45227
890323	18	187	WID	1	417		7	45235
890323	18	187	WID	1	419		7	45237
890323	18	187	WID	1	429		7	45229
890323	18	187	WID	1	431		7	45239
890323	18	187	WID	1	439		7	45228
890323	18	187	WID	1	460		7	45226
890323	18	187	WID	1	482		7	45232
890323	18	187	WID	2	366		1	45230
890323	18	187	WID	2	469		3	45231
890323	18	187	WID	2	489		4	45233
890323	18	187	YT	1	390		1	45005
890323	18	187	YT	1	426		7	45004
890323	18	187	YT	1	475		7	45006
890324	18	187	CAN	1	466		7	43359
890324	18	187	CAN	1	526		7	43360
890324	18	187	CAN	1	530		7	43358
890324	18	187	CAN	2	536		1	43361
890323	18	187	BAB	0	325		0	45308
890323	18	187	BAB	0	332		0	45309
890323	18	187	BAB	1	312		7	45304

Appendix Table B6 (cont'd)

Date	Set No.	Depth (m)	Species	Sex[a]	Length (mm)	Weight (gm)	Maturity	Fish No.
890323	18	187	BAB	1	312		7	45306
890323	18	187	BAB	1	315		7	45307
890323	18	187	BAB	1	327		7	45310
890323	18	187	BAB	1	335		7	45305
890323	18	187	BAB	2	375		3	45303
890323	18	187	BAB	2	378		3	45302
890323	18	187	LC	2	620	6000	7	
890323	18	187	LC	2	965	10000	0	
890323	18	187	LC	2	1010	11000	0	
890323	19	186	SG	1	475		7	43224
890323	19	186	WID	1	398		2	45243
890323	19	186	WID	1	412		2	45244
890323	19	186	WID	1	429		7	45245
890323	19	186	WID	1	445		7	45242
890323	19	186	WID	2	402		1	45246
890323	19	186	YT	1	465		7	45022
890323	19	186	YT	2	555		2	45021
890323	19	186	CAN	1	498		7	43365
890323	19	186	CAN	1	512		7	43366
890323	19	186	CAN	1	519		7	43368
890323	19	186	CAN	1	535		7	43370
890323	19	186	CAN	1	540		7	43371
890323	19	186	CAN	1	542		7	43367
890323	19	186	CAN	2	602		7	43369
890323	19	186	YE	1	260		1	43008
890323	19	186	LC	2	850	8500	0	

Totals Sets =18 Fish= 808 Lengths= 806 Weights= 409

Age structures= 596

[a]0=unknown, 1=male, 2=female

Appendix Table B7. Summary of the length-frequency measurements for red-banded rockfish, Sebastes babcocki.

Length (cm)	Set 10 M	Set 10 F	Set 14 M	Set 14 F	Set 18 M	Set 18 F	Set 19 M	Set 19 F
35								
36								
36							1	
37								
38	1							1
39	1							1
40								
41				1				
42				1				
43								
44			1	1				
45								
46								1
47					1	1		
48								
49	1		1	1				
50								
51								
52			1					
53	1							
54								
55				1				

	Set 10	Set 14	Set 18	Set 19
Total	4	8	2	4
x length	44.8	47.0	47.0	39.8
% female	0	63	50	75

Appendix Table B7 (cont'd). Summary of the length-frequency measurements for greenstriped rockfish, Sebastes elongatus.

Length (cm)	Set 10 M	Set 10 F	Set 13 M	Set 13 F
25				
26				1
27		1		1
28				
29				
30				

	Set 10	Set 13
Total	1	2
x length	27.0	26.5
% female	100	100

Appendix Table B7 (cont'd). Summary of the length-frequency measurements for rosethorn rockfish, Sebastes helvomaculatus.

Length (cm)	Set 14		Set 16		Set 17		Set 19	
	M	F	M	F	M	F	M	F
22								1
23			1	1				
24								1
25								
26	1							
27								
28		1			1	1		
29	1				1			
30								
31								
32								1
33								
34								
35								

	Set 14	Set 16	Set 17	Set 19
Total	3	2	3	3
x length	27.7	23.0	28.3	26.0
% female	33	50	33	100

Appendix Table B7 (cont'd). Summary of the length-frequency measurements for quillback rockfish, Sebastes maliger.

Length (cm)	Set 17 M	Set 17 F
30		
31		
32		1
33		
34		
35		
Total		1
x length		32.0
% female		100

Appendix Table B7 (cont'd). Summary of the length-frequency measurements for sharpchin rockfish, Sebastes zacentrus.

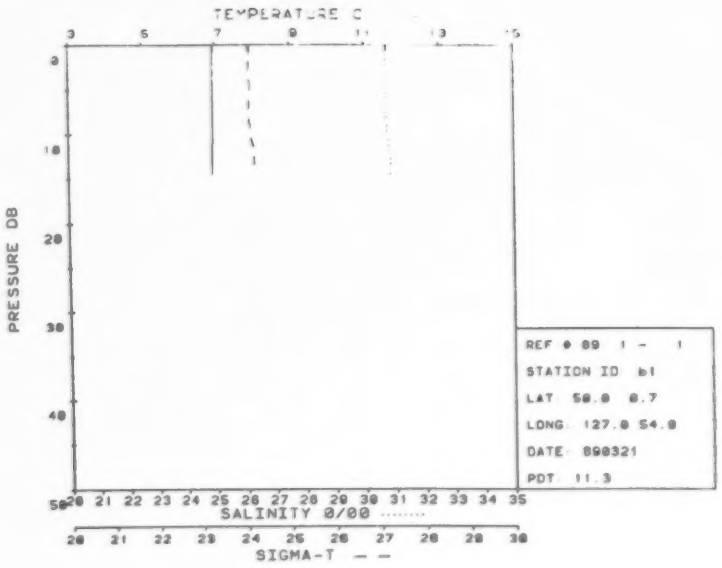
Length (cm)	Set 10		Set 14		Set 18		Set 19	
	M	F	M	F	M	F	M	F
24						1		
25	1		1		1	1		1
26	1		5		1	2		
27			1	2	1	2		
28								1
29						1		
30				1				
31			1	1				
32								
33								
34								
35						1		
36								
37								
38								
39								
40								

	Set 10	Set 14	Set 18	Set 19
Total	2	12	11	2
x length	25.5	27.3	27.0	26.5
% female	0	33	73	100

Appendix Table B7 (cont'd), Summary of the length-frequency measurements for lingcod, Ophiodon elongatus.

Length (cm)	Set 3 M	Set 3 F	Set 7 M	Set 7 F
65				
66				
67				1
68				
69				
70				
71				
72				
73				
74				
75				
76				
77				
78				
79		1		
80		1		
81		3		
82				
83		3		1
84		1		1
85				
86		1		
87				
88		1		
89		1		1
90		2		
91				
92				1
93				3
94				2
95				1
96				
97				2
98				
99				1
100		1		
101				1
102				
103				
104				
105				
106				1
	Set 3		Set 7	
Total	15		16	
x length	85.2		92.3	
% female	100		100	

Appendix Figure A1. Temperature (solid line), salinity (dotted line), and sigma-t (dashed line) profiles from STD cast locations in Brookes Bay.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PRESSURE DB
SALINITY 0/00
SIGMA-T
REF # 89 1 - 1
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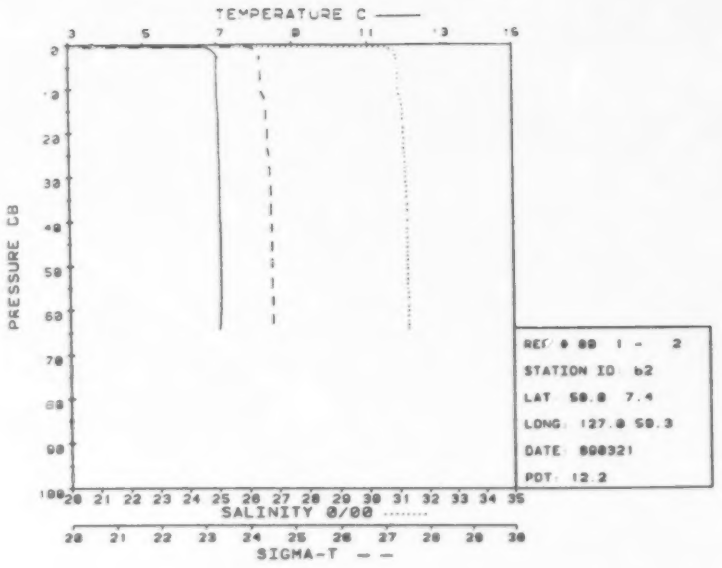
LONG 127.0 54.0
DATE 890321
PDT 11.3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PRESSURE DB
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SIGMA-T
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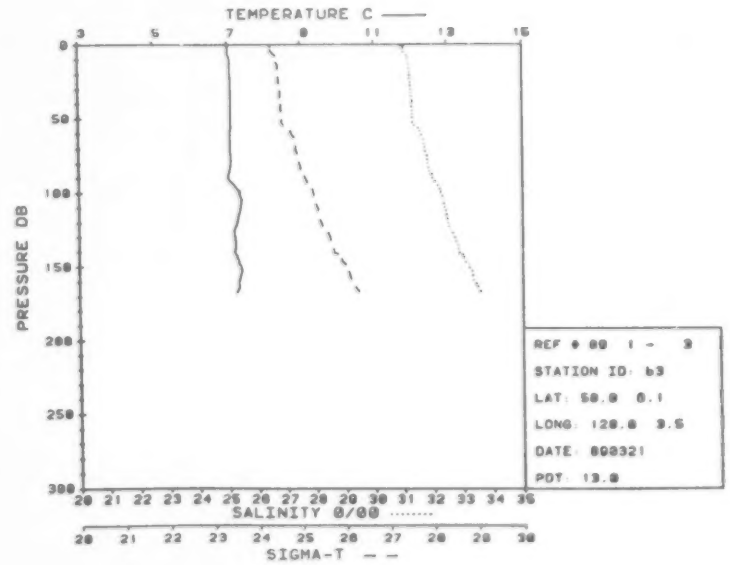
LONG 127.0 59.3
DATE 890321
PDT 12.2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PRESSURE DB
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SIGMA-T
REF # 89 1 - 3
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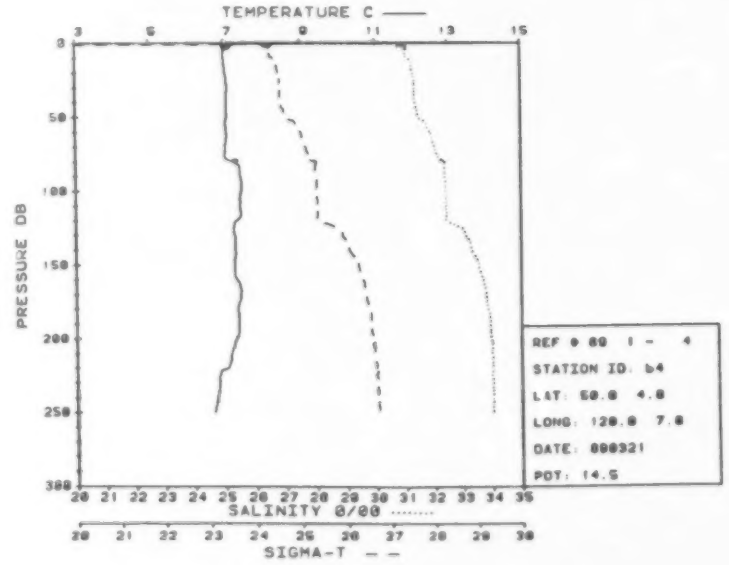
LONG 128.0 3.5
DATE 890321
PDT 13.0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PRESSURE DB
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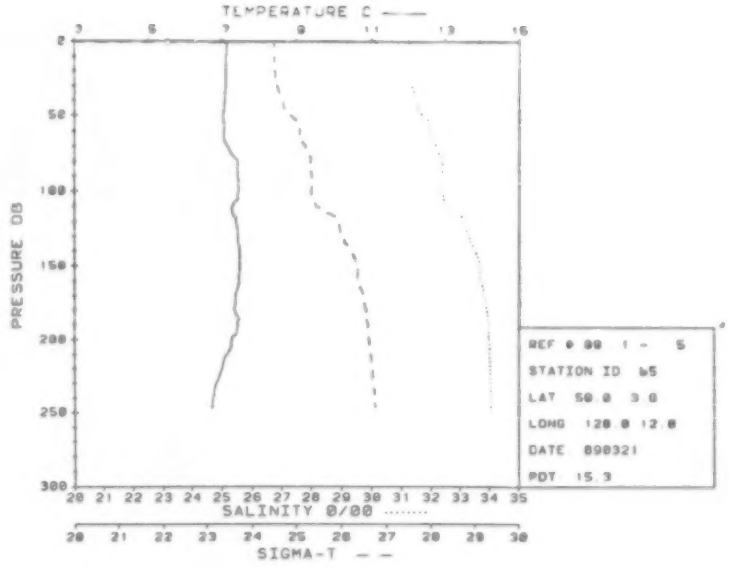
LONG 128.0 7.8
DATE 890321
PDT 14.5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PRESSURE DB
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SIGMA-T
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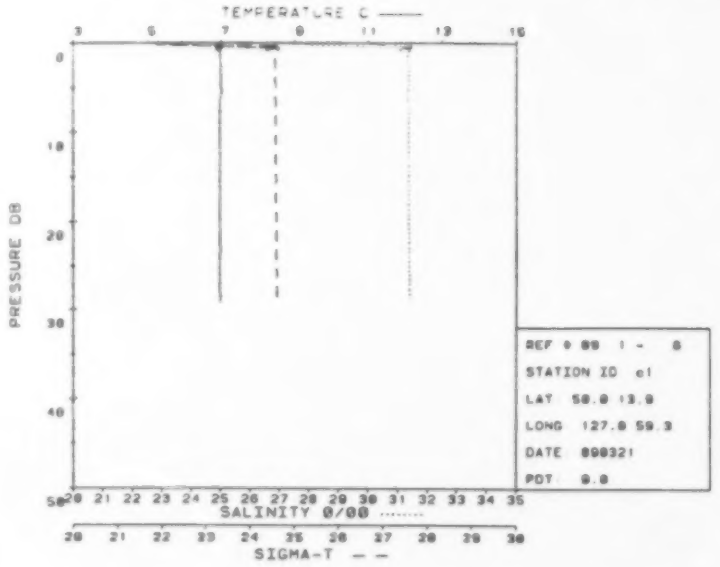
LONG 128.0 12.0
DATE 890321
PDT 15.3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PRESSURE DB
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SIGMA-T
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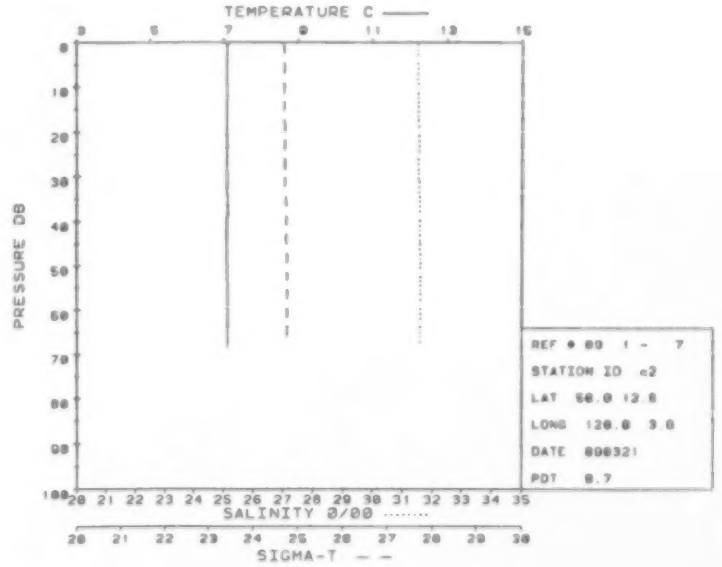
LONG 127.0 59.3
DATE 890321
PDT 9.8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PRESSURE DB
SALINITY 0/00
SIGMA-T
REF # 89 1 - 7
STATION ID c2
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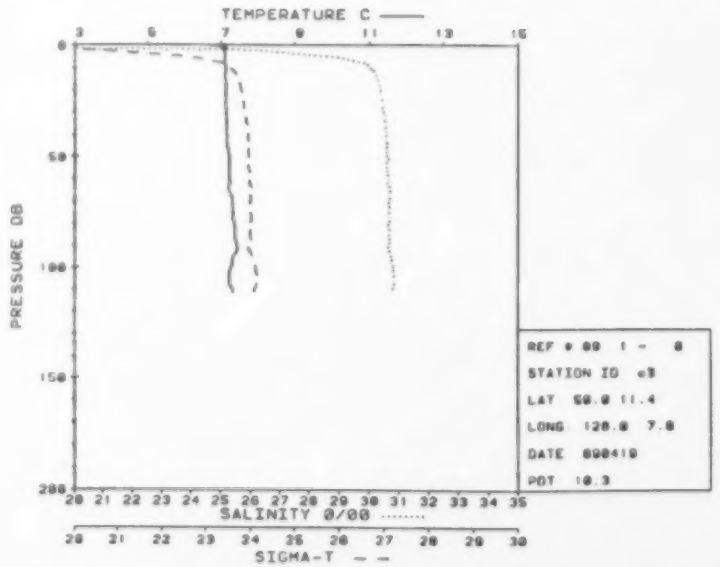
LONG 128.0 3.0
DATE 890321
PDT 8.7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PRESSURE DB
SALINITY 0/00
SIGMA-T
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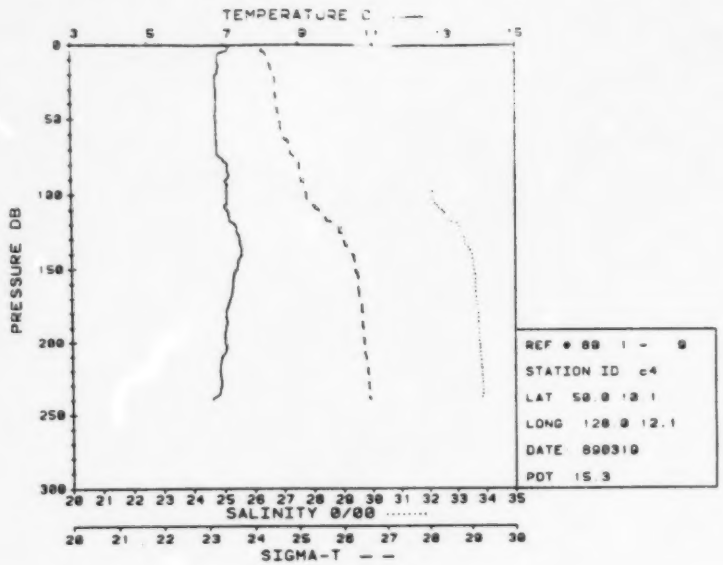
LONG 128.0 7.0
DATE 890419
PDT 10.3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PRESSURE DB
SALINITY 0/00
SIGMA-T
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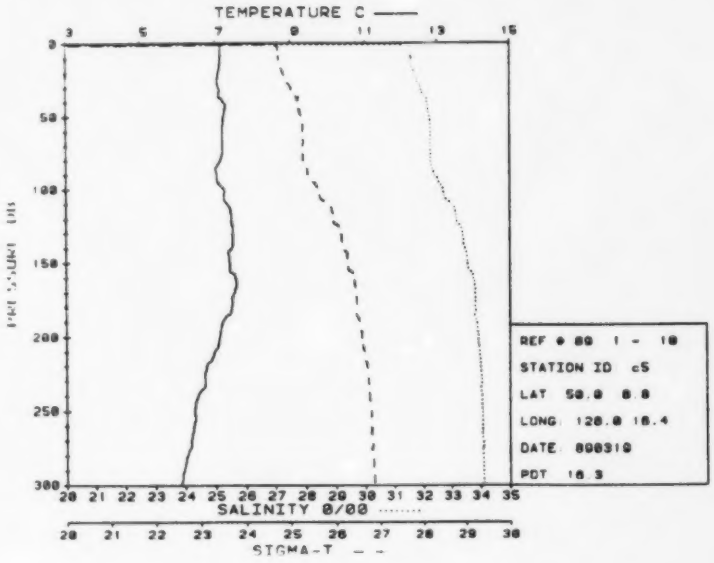
LONG 128.0 12.1
DATE 890310
PDT 15.3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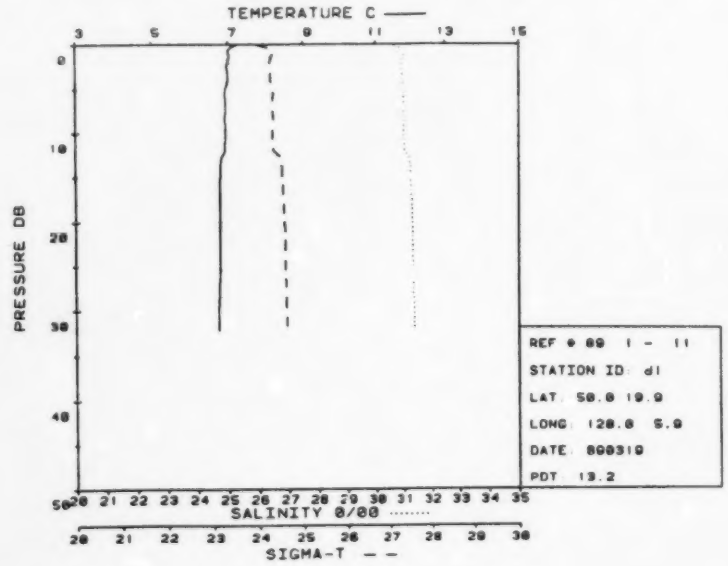
SIGMA-T
REF # 89 1 - 10
STATION ID c5
LAT 50.0 8.8
LONG 128.0 16.4
DATE 890310
PDT 16.3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PRESSURE DB
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SIGMA-T
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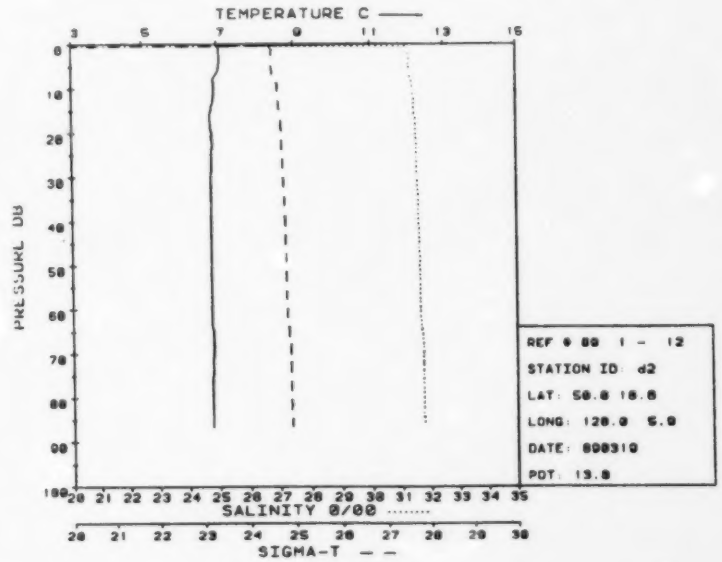
LONG 128.0 5.9
DATE 890310
PDT 13.2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SIGMA-T
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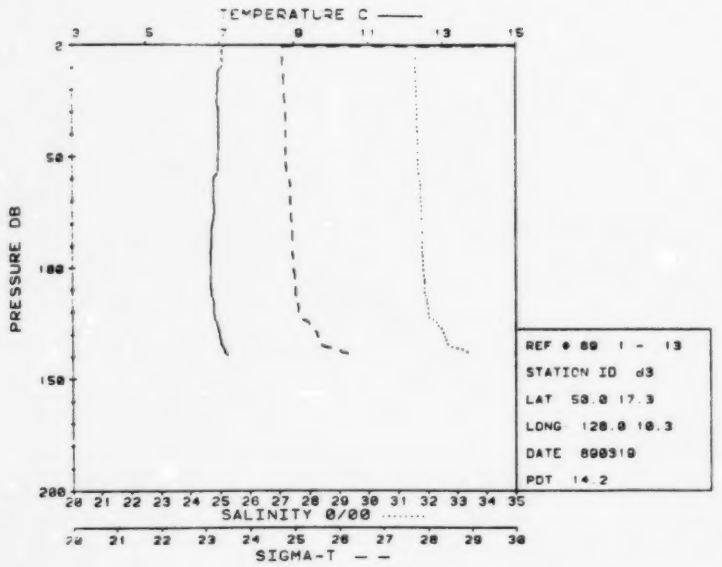
LONG 128.0 5.9
DATE 890310
PDT 13.8


TEMPERATURE C
PRESSURE DB
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SIGMA-T
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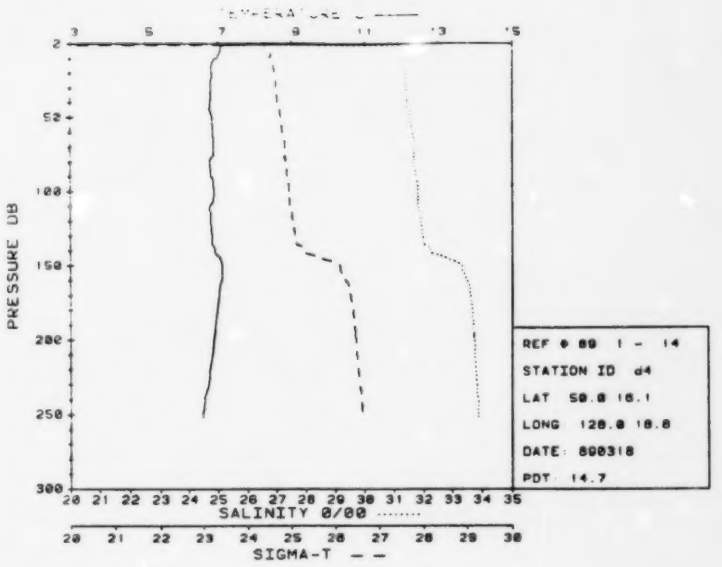
LONG 128.0 18.3
DATE 890319
PDT 14.2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SIGMA-T
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LONG 128.0 18.8
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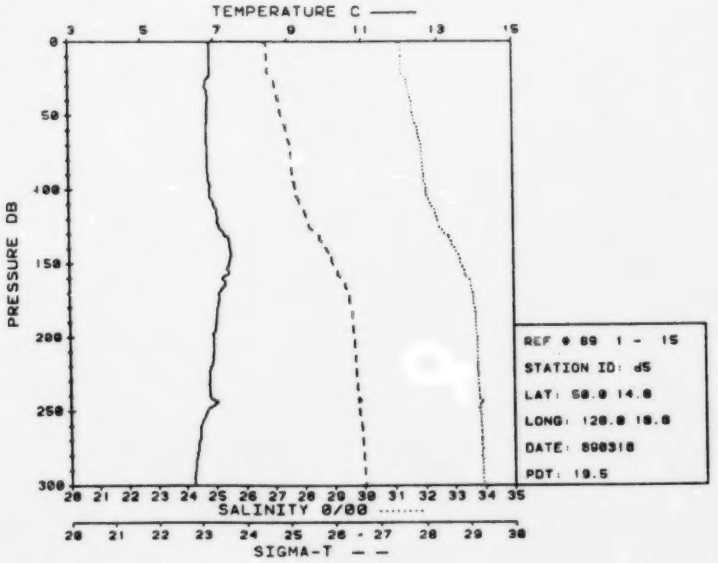
PDT: 14.7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PRESSURE DB
SALINITY 0/00
SIGMA-T
REF # 89 1 - 15
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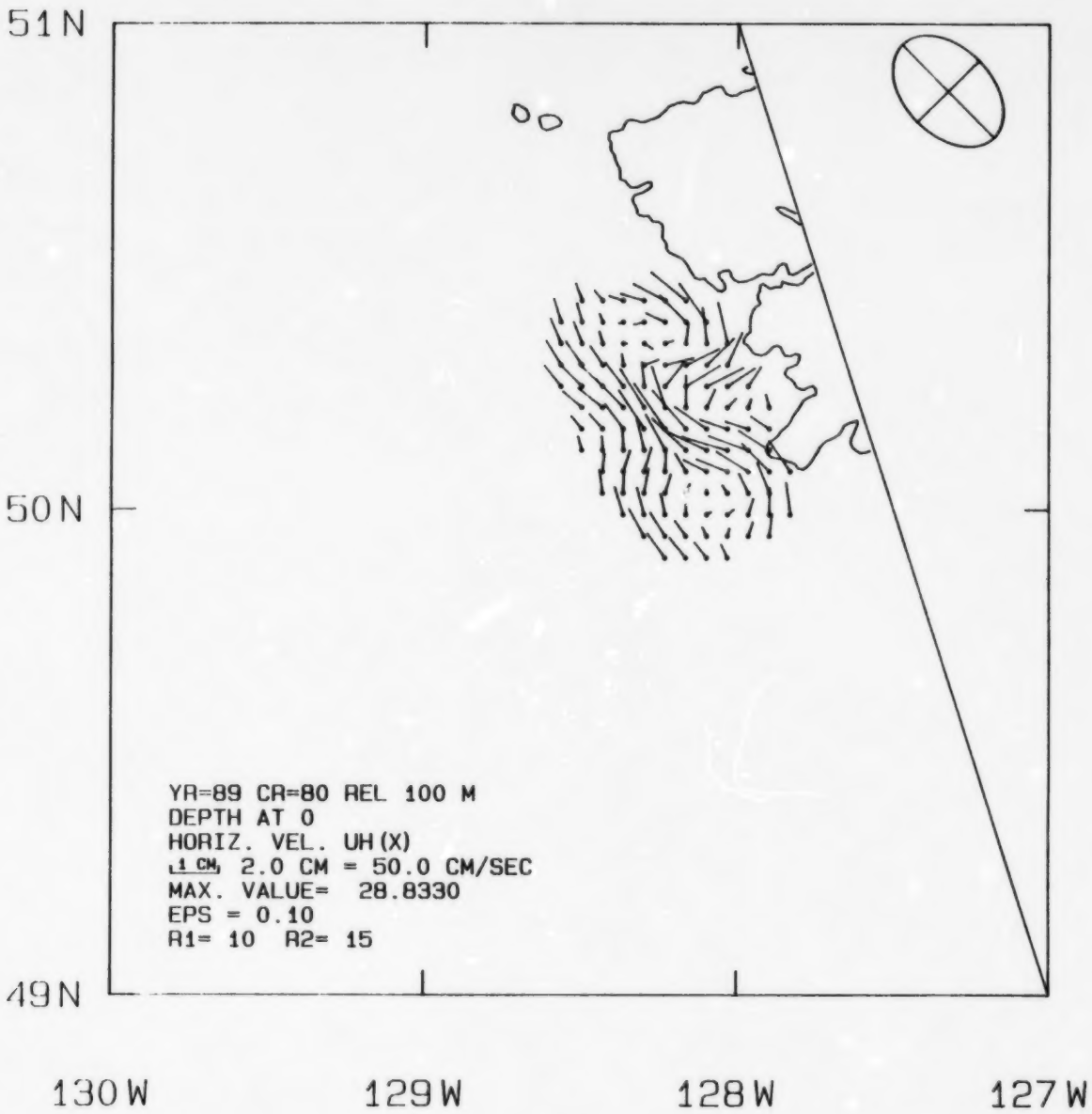
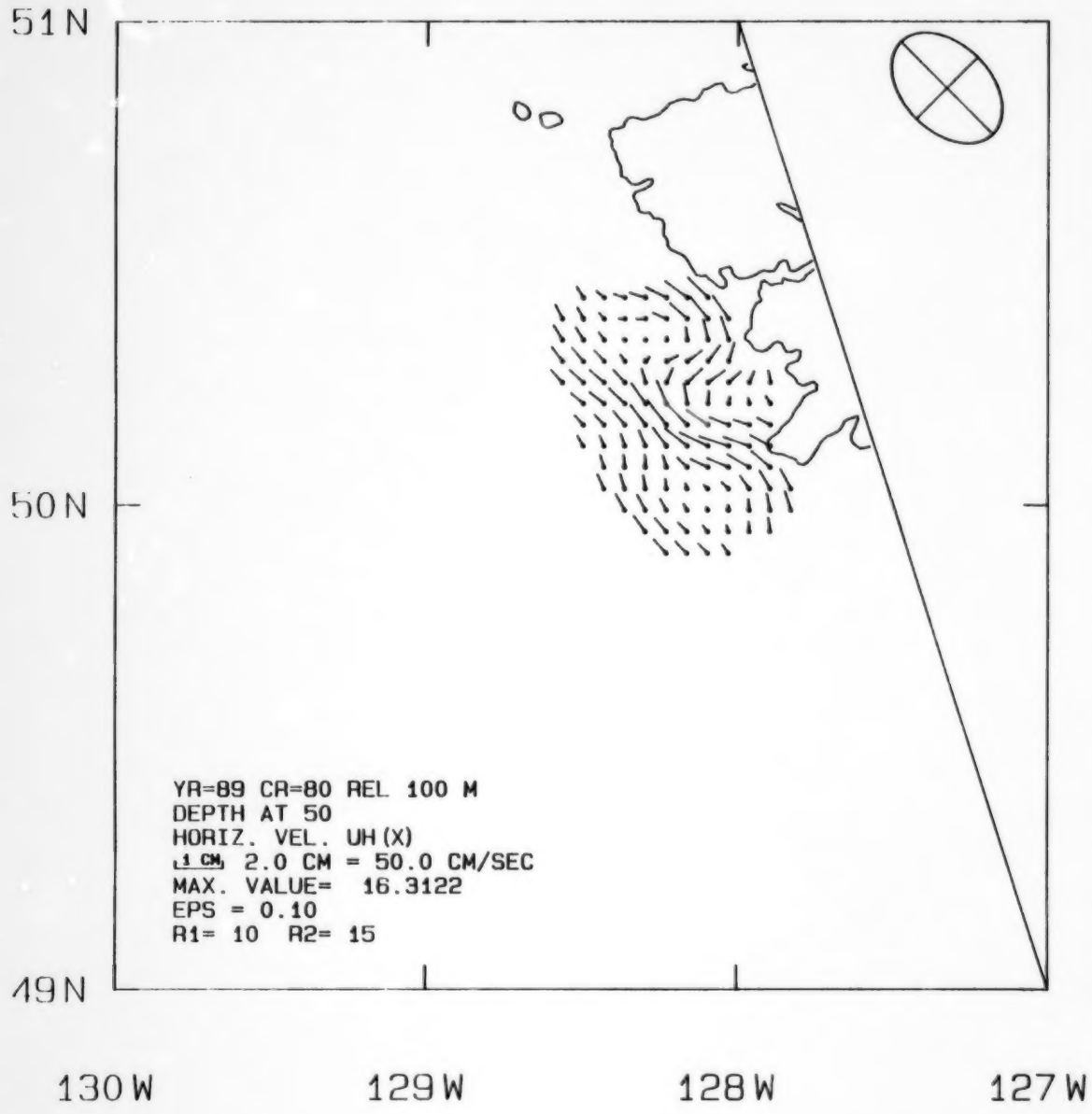
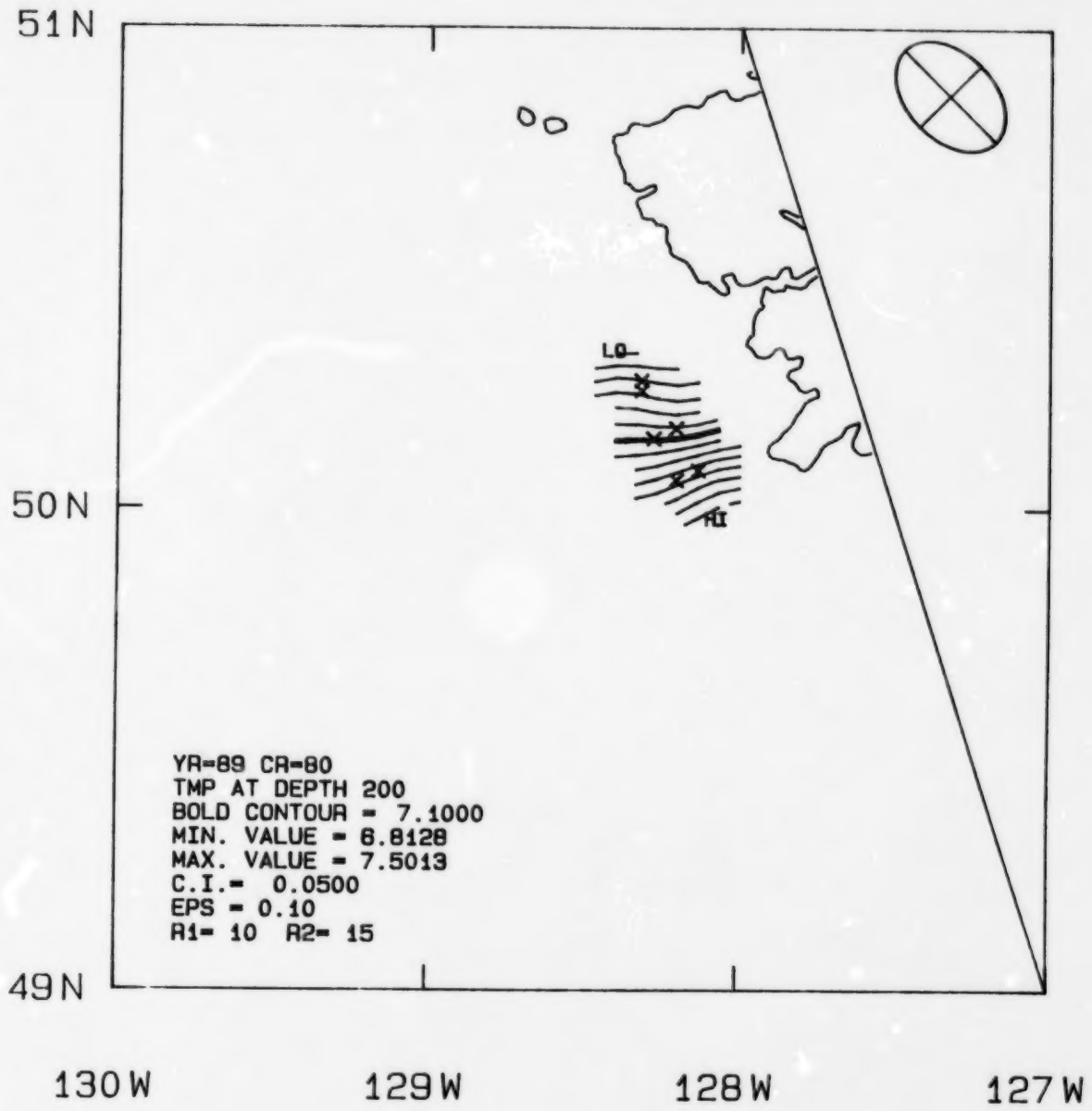
LONG: 128.0 18.8
DATE: 890318
PDT: 19.5



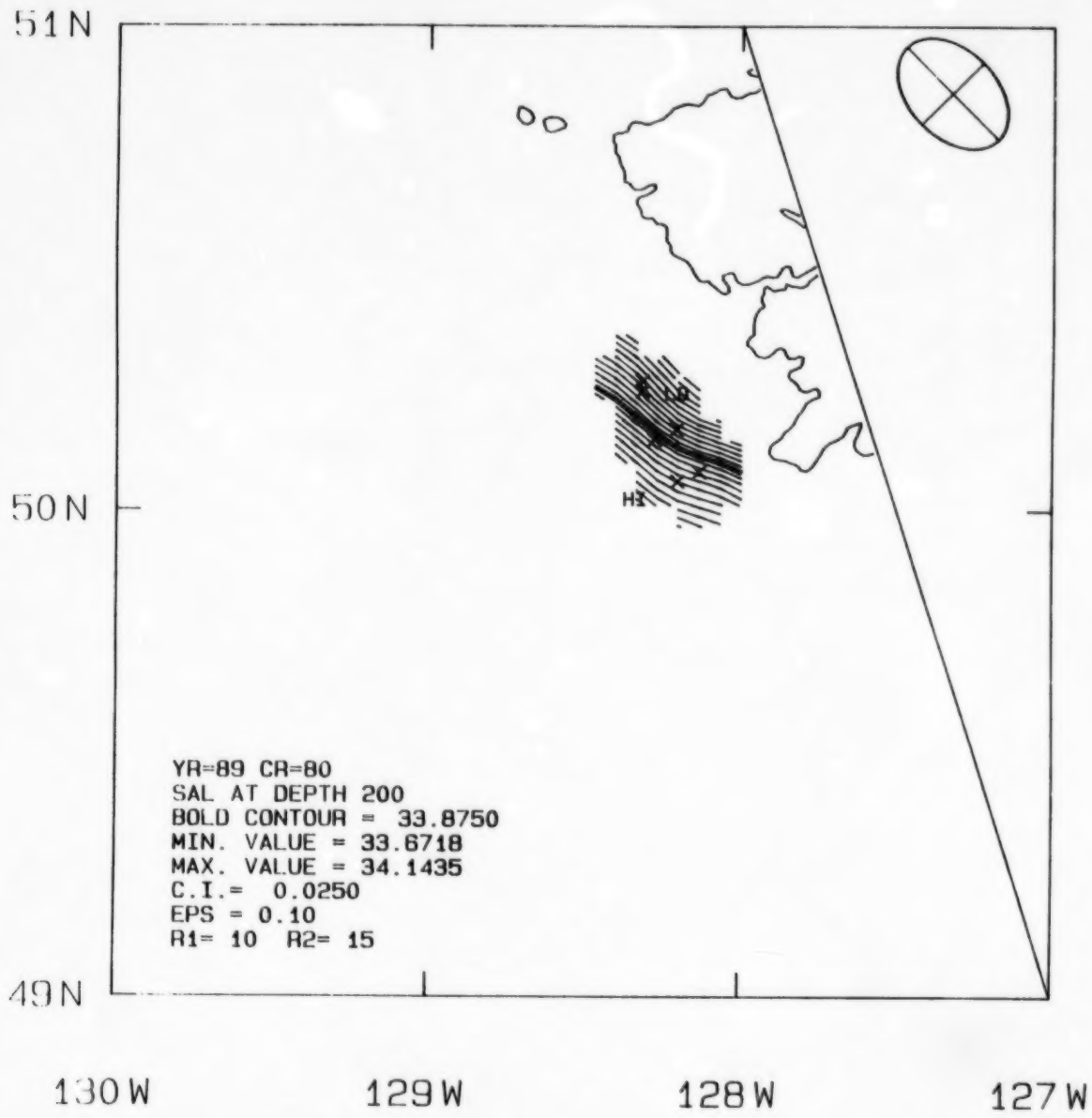
Appendix Figure A2-a. Current vector plots at surface relative to depth 100 m for Brooks Bay.



Appendix Figure A2-b. Current vector plots at a depth of 50 m relative to 100 m for Brooks Bay.



Appendix Figure A2-c. Temperature contours at a depth of 200 m for Brooks Bay.



Appendix Figure A2-d. Salinity contours at a depth of 200 m for Brooks Bay.